JOURNAL

OF THE

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WHITEHALL YARD.

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CONTENTS OF VOLUME THE NINETEENTH.

The Journal

OF THE

Royal United Service Institution.

Vol. XIX. 1876. Appendix.

PROCEEDINGS OF THE FORTY-FIFTH ANNIVERSARY MEETING.

The Forty-fifth Anniversary Meeting of the Members was held in the Theatre of the Institution, on Saturday, the 4th March, 1876.

Admiral Sir Alexander Milne, G.C.B., Lord of the Admiralty, in the Chair.

The Chairman:

Before the business of the Meeting commences, I think that I should state the reason why I have the honour of occupying the Chair on this occasion. It was the intention of the First Lord of the Admiralty to have been here this afternoon, but in consequence of a meeting of the Cabinet at 12 o'clock, he is unable to be present. The Council have been kind enough, therefore, to ask me to preside, and I shall be very glad, if I can be of any service.

I. The Secretary read the notice convening the Meeting.

II. The Secretary read the Minutes of the Forty-fourth Anniversary Meeting.

III. The Forty-fifth Annual Report of the Council was read as follows:—

1. The Council have the pleasure of laying before the Members their Forty-Fifth Annual Report.

Members.

2. Forty-one Life Members and one hundred and thirteen Annual Subscribers, making a total of one hundred and fifty-four new Members, joined the Institution during the past year. The loss by death amounted to ninety-one, and forty-five Members withdrew their names, whilst the names of forty have been struck off the list in consequence of the non-payment of their subscriptions for many years, after frequent applications. The decrease therefore is twenty-two.

A detailed statement of the changes in the List of Members, and a tabular analysis of the present and past state of the Institution, will be found on pages vii. and viii.

Finance.

3. The usual Abstract of the Yearly Accounts, as audited on the 10th February, will be found on the following page.

B

GENERAL ABSTRACT OF THE ACCOUNTS OF THE ROYAL UNITED SERVICE INSTITUTION, FROM 1st JANUARY to 31st DECEMBER, 1875.

EXPENDITURE.

	£ s. d.	£ s. d.
Secretary's Salary	325 – –	
Ditto Lodging Allowance	50 – –	375 – –
Librarian's Salary...	... ...	200 – –
Clerk's Salary	... ...	100 8 –
Servants' Wages	... ...	514 4 6
Ditto Clothing...	... ...	71 1 6
Insurance...	... ...	11 10 –
Ground Rent	... ...	203 15 9
Fuel	... ...	58 – –
Lighting	... ...	66 1 9
Assessed and Income Taxes	... ...	56 17 3
Parish and Water Rates	... ...	95 – 8
Artificers	... ...	104 4 8
Museum	... ...	28 9 1
Gold Medal	... ...	80 11 6
Library, Reading, and Topographical Rooms ...	... ...	227 13 10
Advertisements	... ...	238 13 –
Printing Circulars and Stationery	... ...	171 9 3
Lectures	... ...	44 8 6
Journals, including Annual Report and List of Members	... ...	1,188 2 8
Postage { Letters...	31 4 –	
Postage { Journals	195 12 5	226 16 5
House Expenses and Sundries	... ...	41 4 7
Cash repaid to Agents	... ...	7 – –
Charges from ditto	... ...	– 3 3
Balance at Bankers	... ...	38 14 5
		£4,149 10 7
For £531 18s. 7d. Consols, Life Subscriptions... ...	... ...	500 – –
Balance at Bankers	... ...	127 – –
Total Income and Life ...	...	£4,776 10 7

RECEIPTS.

	£ s. d.	£ s. d.
Balance at Bankers. 31st December, 1874		123 13 8
Annual Subscriptions, at 10s.	278 – –	
,, ,, above 10s.	2,454 13 –	
,, ,, arrears	50 10 –	
,, ,, advance	15 10 6	
Increased Subscriptions, at 10s.	2 10 –	2,801 3 6
Entrance Fees	... ...	154 1 –
Dividends	... ...	342 14 10
Interest on Exchequer Bills	... ...	21 14 5
Government Grant	... ...	600 – –
Sale of Journals	... ...	102 12 5
Miscellaneous Receipts	... ...	3 10 9
		£4,149 10 7
Balance of Life Subscriptions at Bankers, 31st December, 1874	...	57 10 –
Life Subscriptions	... ...	469 10 –
Legacy	...	100 – –
Total Income and Life		£4,776 10 7

Examined and found correct, 10th February, 1876.

EDW. DRAPER
[illegible] G. RIDGWAY } Auditors.

T. D. SULLIVAN, Accountant.

Estimate of Receipts and Expenditure for the Year 1876.

Expenditure.	£	s.	d.	Receipts.	£	s.	d.
Secretary's Salary and Lodging allowance	400	-	-	Balance at Bankers, 31st Dec., 1875	165	-	-
Librarian and Accountant's do.	210	-	-	Annual Subscriptions:			
Clerk's do.	104	-	-	At 10s. .. £270 - -			
Servants' Wages	520	-	-	Above .. 2,500 - -			
Ditto Clothing ..	75	-	-				
Insurance	18	-	-		2,770	-	-
Ground Rent	205	-	-	Entrance Fees	170	-	-
Fuel	70	-	-	Dividends	350	-	-
Lighting	70	-	-	Interest on Exchequer Bills	20	-	-
Assessed and Income Taxes	60	-	-				
Parish and Water Rates	140	-	-	Government Grant ..	600	-	-
Artificers, Repairs, &c. ..	100	-	-	Sale of Journals	100	-	-
Museum	50	-	-				
Gold Medal	10	-	-				
Library and Topographical Departments	250	-	-				
Advertisements	150	-	-				
Printing Circulars, & Stationery	180	-	-				
Lectures	50	-	-				
Journals, including Printing Annual Report and List of Members ..	1,100	-	-				
Postage of Journals ..	200	-	-				
Postage	50	-	-				
House Expenses and Sundries	60	-	-				
Balance ..	103	-	-				
Total.. ..	£4,175	-	-	Total.. ..	£4,175	-	-

Life Subscriptions.

4. Life Subscriptions to the amount of £531 18*s.* 7*d.*, including £57 10*s.* not invested last year, and the sum of £100, bequeathed to the Institution by the late Captain Jefferson, Ceylon Rifles, for many years an active Member of the Council, have been invested in Three per Cent. Consols.

Capital Account.

5. The funded property of the Institution on the 1st January, 1876, was £10,721 1*s.* 3*d.*, as compared with £10,189 2*s.* 8*d.*, on the 1st January, 1875.

The Future Locality of the Institution.

6. The Council regret that they are still unable to submit to the Members any proposal as to the future locality of the Institution, no steps having been taken by the Government for the appropriation of the building sites on the Crown property in this neighbourhood.

B 2

Lectures and Journal.

7. Thirteen Lectures were delivered, and eighteen Papers were read and discussed in the Theatre of the Institution during the past Session. As the subjects suitable for treatment in a Military Institution are necessarily limited in number, the Council consider this result very satisfactory, and they take this opportunity of recording their best thanks to those Gentlemen who thus afforded so much valuable professional information.

The Council are happy to report that the Journal maintains its high character, and is much appreciated both at home and abroad.

The series of Coloured Plates of Minute Sea-Surface Animals published in the Journal, having drawn the attention of some of the Members to Microscopical observations, the Council desire to inform the Members that the valuable Microscope in the Library, having been cleaned and repaired, is now available for their use.

Library.

8. Three hundred and seventy-eight volumes were added to the Library during the past year; of these, 159 were purchased and 219 presented. Among the latter, the following are the most noteworthy:—

By the Austrian Government—
Mittheilungen über Gegenstände des Artillerie- und Genie-Wesens.
Mittheilungen aus dem Gebiete des Seewesens.
Organ des Wiener militärwissenschaftlichen Vereins.

By he French Government—
Revue Maritime et Coloniale.
„ *Militaire de l'Etranger.*
Twelve Sheets of the Map of France $\frac{1}{80,000}$.

By the German Government—
Archiv für die Artillerie- und Ingenieur-Offiziere des Deutschen Reichsheeres.
Jahrbücher für die Deutsche Armee und Marine.
Militärische Blätter.
Militär-Literatur-Zeitung.
Neue Militärische Blätter.

By the Netherlands Government—
Four Plates of "Matériel de l'Artillerie."

By the Russian Government—
Engineering Journal.
Naval Review.

By the Saxon Government—
Three Volumes on Military Hygiène.

By the Spanish Government—
Memorial de Ingenieros.

By the SWEDISH Government—
Sixteen Volumes, Krigs-Vetens-Kaps Akademiens Handlingar.

By the UNITED STATES Government—
Twenty-eight Volumes, on various Naval and Military subjects.

The exchange of Journals with Foreign Governments, and with various Scientific Societies, in this and other Countries, has been continued.
The Library now contains upwards of 17,000 volumes.

TOPOGRAPHICAL DEPARTMENT.

9. The Secretary of State for War has presented Photographs and Lithographs of Guns, Casemates, Shields, Targets, &c., and copies of the works published by the War Office.

The Institution has also received from the Lords Commissioners of the Admiralty, Charts, Sailing-Directions, and other valuable works.

MUSEUM.

10. The additions to the Museum and to the Library will be found recorded in the Proceedings of this day's Meeting, and in the Appendix to Vol. XIX of the Journal; the following, however, may be noted :—

Armoury.—A Mauser Rifle with Sword-bayonet, presented by His Majesty the Emperor of Germany.
A "Swinburn" Military Breech-loading Rifle, and Sectional Model showing the Breech-action, by Mr. J. F. Swinburn.

Gun Model Room.—Model of Moncrieff's Hydraulic Carriage for a 38-ton Gun.
Model of 38-ton ML Gun, $\frac{1}{4}$-size.

Military Model Room.—A Series of Models, illustrating Military Bridge-construction, especially during the late Ashanti Campaign, and
Model of Service Pontoon Boat, with Carriage, Raft, and Stores complete. Presented by Lieut.-Colonel Leahy, R.E.

Topographical Model Room.—An elaborate Model, by Herr Walger, of Berlin, of the Battle Fields round Orleans, during the late Franco-German War. Horizontal scale $\frac{1}{8000}$: Vertical scale $\frac{1}{4000}$.

The thanks of the Council have been tendered to the several Foreign Governments; to the Secretaries of State for War and for India; to the Lords Commissioners of the Admiralty, and to the various Donors, for their respective presents to the Library and to the Museum.

VICE-PATRONS.

11. The Council regret to record the deaths of two Vice-Patrons of the Institution, viz., Field Marshal Sir William Maynard Gomm, G.C.B., and Admiral of the Fleet Sir Houston Stewart, G.C.B.

Sir William Gomm became a Member of the Institution at its foundation in 1831, and in 1868, on his promotion to the rank of Field Marshal, was elected a Vice-Patron.

Sir Houston Stewart also became a Member of the Institution at its foundation in 1831, and was elected a Vice-Patron on becoming Admiral of the Fleet in 1873.

The Council have had the pleasure of electing Field Marshal the Marquis of Tweeddale, K.T., G.C.B., &c., &c., &c., a Vice-Patron of the Institution.

Honorary Members.

12. The Council have admitted several Officers of Foreign Armies, as Honorary Members, during their stay in this country.

Corresponding Members of Council.

13. There were 337 Corresponding Members of Council on the 1st January, 1876. This number shows a slight decrease as compared with the number on the 1st January, 1875.

The Council earnestly invite the co-operation of their Corresponding Members in making the advantages of Membership more generally known throughout the Services.

Gold Medal.

14. Eight Essays were received on the 1st November, 1875, in competition for the Gold Medal of the Institution, the subject being: "On the Best Types of War-Vessels for the British Navy." Admirals Sir James Hope and Sir Thomas Symonds, and Rear-Admiral Luard, kindly undertook the duties of Referees. Their award will now be made known to the meeting.

The subject for this year is, "The causes which have led to the Pre-eminence of Nations in War," and the competition is thrown open to all Members of the Institution.

Conclusion.

In concluding this their Forty-fifth Annual Report, the Council congratulate the Members on the satisfactory condition of the Institution.

STATEMENT OF CHANGES AMONG THE MEMBERS SINCE 1ST JANUARY, 1875.

	Life.	Annual.	Life.	Annual.	Total.
Number of Members, 31st December, 1874 ..			1,071	3,259	4,330
,, ,, joined during 1875 ..			41	113	154
			1,112	3,372	4,484
Changed from Annual to Life			+11	−11	
			1,123	3,361	4,484
Deduct—Deaths during 1875 ..	21	70			
Withdrawals.. ..	—	45			
Struck off	—	40			
	21	155	21	155	176
Number of Members on 1st January, 1876			1,102	3,206	4,308

Tabular Analysis of the State of the Institution
To 31st of December, 1875.

Year. 1st Jan. to 31st Dec.	Annual Subs. received.	Entrance Fees.	Income (from all sources).*	Life Subs. received.	Amount of Stock.	Invested in the purchase of Books, &c.	No. of Vols. in Library.	No. of Members on the 31st Dec.	Number of Visitors
	£	£	£	£	£	£			
1831	654	..	654	1,194	..	..	..	1,437	..
1832	1,146	..	1,146	973	..	..	..	2,699	..
1833	1,405	..	1,450	692	..	..	..	3,341	..
1834	1,500	..	1,549	583	1,100	..	..	3,748	13,376
1835	1,480	..	1,574	366	2,430	40	..	4,155	8,537
1836	1,570	..	1,682	330	3,747	45	..	4,069	8,521
1837	1,549	..	1,747	222	4,747	180	..	4,164	10,907
1838	1,462	..	1,634	230	5,500	246	..	4,175	15,788
1839	1,399	..	1,565	168	5,500	292	..	4,186	16,248
1840	1,363	..	1,525	198	5,500	446	5,500	4,257	17,120
1841	1,450	..	1,643	186	6,000	243	5,850	4,243	19,421
1842	1,373	..	1,565	144	6,400	373	6,450	4,127	21,552
1843	1,299	..	1,494	140	6,700	237	7,000	4,078	27,056
1844	1,274	..	1,408	112	3,000	298	7,850	3,968	22,767
1845	1,313	..	1,466	228	1,500	127	8,100	3,988	21,627
1846	1,298	..	1,456	138	1,500	74	8,410	4,031	32,885
1847	1,314	74	1,502	132	1,700	37	..	4,017	38,699
1848	1,175	57	1,375	48	1,700	85	9,641	3,947	37,140
1849	1,176	72	1,375	84	1,150	58	..	3,970	33,333
1850	1,141	106	1,294	198	600	36	..	3,998	33,773
1851	1,136	131	1,292	66	666	34	10,150	3,188	52,173
1852	1,134	133	1,281	114	200	43	10,300	3,078	20,609
1853	1,243	319	1,684	264	528	41	10,420	3,251	25,952
1854	1,200	138	1,368	126	612	95	10,587	3,171	22,661
1855	1,159	107	1,289	120	653	55	10,780	3,131	14,778
1856	1,216	197	1,519	156	761	47	10,832	3,204	16,184
1857	1,258	176	1,937	78	1,038	40	10,960	3,168	12,755
1858	1,318	221	2,102	105	438	31	11,062	3,246	25,747
1859	1,526	195	2,277	512	946	70	11,320	3,344	28,739
1860	1,961	298	3,577	397	2,178	114	11,517	3,518	28,011
1861	2,122	305	2,899	266	2,846	99	11,812	3,689	23,296
1862	2,296	242	3,127	239	3,178	109	12,026	3,797	27,215
1863	2,379	218	3,100	405	3,583	143	12,296	3,847	18,150
1864	2,425	215	3,253	222	4,516	116	12,700	3,902	17,276
1865	2,435	154	3,467	235	4,804	137	13,000	3,895	18,253
1866	2,435	157	3,488	299	5,486	150	13,337	3,891	17,067
1867	2,431	141	3,467	208	5,732	140	13,800	3,823	17,211
1868	2,446	184	3,534	297	6,396	119	14,100	3,812	16,417
1869	2,368	165	3,485	238	6,653	232	14,669	3,792	15,947
1870	2,376	178	3,493	333	7,313	140	15,055	3,831	18,654
1871	2,455	237	3,677	538	7,748	202	15,501	3,922	19,420
1872	2,620	336	4,111	713	8,927	192	15,761	4,116	19,773
1873	2,776	295	4,316	535	9,465	222	16,227	4,276	18,183
1874	2,819	216	4,491	409	10,189	218	16,624	4,330	16,771
1875	2,801	154	4,595	469	10,721	228	17,000	4,308	15,960

* Including annual subscriptions, entrance fees, donations, legacies, interest on funded property, and grant from Government, commencing in 1857.

IV. Admiral Sir WILLIAM H. HALL, K.C.B. :—

I rise to propose the first Resolution :—

"That the Report now read be adopted and printed for circulation amongst the members."

The Report appears to be very satisfactory, and I am sure that you will all join with me in wishing success to the Institution.

The Resolution having been seconded by Major-General Baillie, Bengal Staff Corps, was then put from the Chair, and was carried unanimously.

The Names of the Eight Members retiring from the Council by rotation were read as follows:—

Colonel H. HUME, C.B.
Major-General F. C. A. STEPHENSON, C.B.
Major-General Sir ANDREW S. WAUGH, Kt., F.R.S.
Lieut.-General Sir RICHARD WILBRAHAM, K.C.B.
Major-General C. L. B. MAITLAND, C.B.
Lieut.-General G. A. SCHOMBERG, C.B., R.M.A.
Major-Gen. W. J. SMYTHE, R.A., F.R.S., &c., &c.,
Colonel Lord ELCHO, M.P., &c., &c., &c.

Major HALE, R.E. :—

I have to move—

"That the thanks of this Meeting be given to the Members of the Council who retire by rotation, and that the following members be elected to fill the vacancies, namely :—

Col. HENRY HUME, C.B.
Major-General F. C. A. STEPHENSON, C.B.
Lieutenant-General Sir RICHARD WILBRAHAM, K.C.B.
} For Re-election
Lieut.-General Sir EDWARD HODGE, K.C.B.
Lieut.-Colonel W. H. GOODENOUGH, R.A.
Lieut.-Col. T. D. BAKER, C.B., 18th Royal Irish.
Col. C. B. EWART, C.B., R.E.
Captain Sir JOHN COMMERELL, V.C., K.C.B., R.N.

And that the following names be adopted from which to select in the event of vacancies occurring in the Council, viz. :—

Vice-Admiral H. DUNLOP, C.B.
Captain H. F. NICHOLSON, R.N.
Colonel H. C. FLETCHER, C.M.G.
Major-General D. LYSONS, C.B."

The Resolution having been seconded by Rear-Admiral Luard, C.B., was put from the Chair, and was carried unanimously.

Lieutenant-General Sir RICHARD WILBRAHAM, K.C.B. :—

I beg to move—

"That the thanks of this Meeting be given to the Auditors for their valuable services, and that the following gentlemen be elected for the ensuing year, viz. :—

Captain DOLBY (for Re-election),
T. E. DRAPER, Esq.,
T. G. RIDGWAY, Esq.,
E. R. RAITT, Esq.

I should like to call your attention to the valuable services that have been rendered especially by Captain Dolby and Mr. Smith. Captain Dolby, I believe, for upwards of twenty years has never failed us till this year, when he was prevented attending by illness, but has always given us his valuable services."

Mr. STIRLING LACON :—

I am glad to have the opportunity of seconding this vote of thanks to the Auditors, because the signatures of those four gentlemen relieve those who have

charge of the finances of this Institution from a certain responsibility, and I believe show also that the finances of this Institution have been satisfactorily attended to.

The Resolution was then put from the Chair, and was carried unanimously.

THE GOLD MEDAL.

The SECRETARY :—

The following is the note from the Referees to the Secretary of the Institution :—

"Dear Sir,—Do us the favour to acquaint the Committee that we award the Prize to the author of the Essay the motto of which is 'Sequitando si guinge.'"

(Signed) JAMES HOPE.

The CHAIRMAN :—

It is my duty as Chairman to announce the name of the successful candidate of the Essay "On the Best Type of War Vessels for the British Navy," and to present the Gold Medal; also, to announce the following subject for the Prize Essay of the current year, viz., "The Causes which have led to the Pre-eminence of Nations in War." I now open the letter which contains the signature, and I beg to state it to be that of Commander Gerard Noel, R.N. It is a very pleasing duty to me on this occasion to have the pleasure of making this announcement, because it so happens that this officer is the one who gained the prize two years ago at the Professional Society at Portsmouth for his Essay on "The Gun, the Ram, and Torpedo." There is only one remark I wish to make, and it is this, viz., that one cannot help regretting that more competitors have not come into the field on so interesting a subject—more interesting than any one single subject connected with Her Majesty's Navy. We have seen for years past the constant increase by degrees in the armaments; we have seen the constant increase in armour-plating; we have constantly seen the necessity for increase of speed; and, with increase of speed, I may say the diminution in stowage of coal. I only regret that so few officers have come forward to write upon a subject so exceedingly difficult; at the same time, it is a great gratification to me to be here as your representative, and it would have been a pleasing duty to have presented the medal to Commander Noel, but that he is unfortunately absent on service; I must therefore present it to the Chairman of the Council in his name.

Vice-Admiral Sir FREDERICK NICOLSON, Bart., C.B. :—

I have to propose a vote of thanks to the three officers who kindly undertook the duty of Referees. Sir Alexander Milne has already alluded to the fact that there were only eight competitors for our Gold Medal of this year. It certainly is a matter of regret that we have not made a better show, the competition being the first one for the naval medal. For the army medal there were nearly eighty competitors; for our medal only eight. I think there are many causes to which we may attribute the difference in the numbers. In the first place, naval officers are far less numerous; for instance, the number of Naval Members of this Institution, as compared with those in the Army, is very small, and naval officers are dispersed about the world away from the sources of information and books of reference which they might naturally wish to consult in writing this Essay. These are causes which probably have tended to diminish the number of competitors. At the same time, I feel bound, as one taking a deep interest in this Institution, to notice a sort of rumour which is abroad—I might perhaps call it an impression—that officers on full pay and officers on the active list had better keep themselves very quiet, and not write or speak more than they can help on matters concerning the Service. After what has fallen from Sir Alexander Milne, who regrets that more competitors have not appeared on this occasion, I am quite sure that we may feel confident that the Admiralty do not look with any disfavour upon those of the younger officers and the officers in active employment who are desirous of studying, and writing, and speaking upon matters so highly interesting and so important. I may also mention

that we have to thank the Admiralty for their kindness in distributing the Circular in which we called upon the Naval Officers afloat to write Essays for the Gold Medal. Therefore, if there be any sort of impression abroad that the Admiralty do not wish the officers to compete for our Medal, or do not wish them to discuss publicly these professional subjects, I trust such impressions may be removed. Of course I am not speaking of matters of discipline, which we all know must be avoided, or of confidential information, which no officer ought to publish; but general topics, such as those for which this Medal is a reward to the successful Essayist, are subjects which may be properly handled, both with the pen and by word of mouth in this Institution, which is expressly intended for discussing such matters. I am afraid I have rather digressed from what I have to bring before you; but I now propose "that a vote of thanks—and I am sure it will be a very cordial one, although their labours have not been very heavy—be given to Admiral Sir James Hope, Admiral Sir Thomas Symonds, and Rear-Admiral Luard for their valuable services in adjudicating upon the Naval Medal."

General Sir William Codrington, G.C.B.:—

I beg to second the Resolution, and I think on the part of the Army I may confirm the feeling of Sir Frederick Nicolson, namely, that discussions on those particular points to which he has referred are valuable in this our Institution; and, therefore, I believe that the authorities, both of the War Office and of the Admiralty, must feel that an immense amount of information is given to the profession and to the general public, and, indeed, I think I may say also to the heads of both professions, by the discussions that take place here. So long as that is done in a fair and gentlemanlike spirit, not interfering with discipline, I hope we shall always have the support of the heads of the two military branches of the service. With regard to the Resolution I perhaps may congratulate the Referees on only having had eight essays to read; but I dare say that this small number arose very much from the transition state of the navy at this moment. I have not entered minutely into the question, but it is very possible that the very great and sudden changes that have taken place, have rather disinclined officers of the Navy to pledge themselves to any particular views. At the same time the thanks of the meeting are certainly due to the Referees for the trouble they have taken, and for the great research which is rendered necessary in dealing with the comparative merits of the suggestions on the different subjects mentioned in detail. It is really a difficult question to decide upon, though in this case it has been made more easy by there being few competitors.

The Resolution was then put from the Chair, and was carried with acclamation.

The Chairman:—

I am very much obliged to Sir Frederick Nicolson for what he has said when referring to the few papers which have been put forward with regard to the type of ship for the British navy? Perhaps there is an impression that the Admiralty have rather objected to this in consequence of their having rather put a damper upon a question that was to have been brought forward here with regard to a prospective "Polar expedition." I think I may say the impression was that it was better not to write upon a question—

Sir F. Nicolson:—

I had not that in my mind.

The Chairman:—

But I had it in my mind—that it was rather injudicious for an officer of the expedition to write a prospective account of an expedition about to take place—that it was a little inopportune, and might, perhaps, fetter the hands of those who were

to conduct the expedition. But I am quite sure of this, the more young officers write upon technical subjects, avoiding all questions of discipline, and not making use of confidential papers, the more it will be for the good of the Service itself, and also of the military profession.

I trust you will allow me to add a few words with regard to the Institution itself. I think nobody can form any other opinion than that it has been of the greatest professional use both to the army and navy, and that there are matters discussed and papers written in this Institution by members of both services which are exceedingly advantageous, and hold forth not only old but new views upon all these particular questions now arising in our respective professions. To whom are we indebted for all this? We are indebted to the Chairman, the Council, the Secretary, and the other Professional Officers of the United Service Institution. These gentlemen are catering for the public good, and I think it is due to them that, as the Chairman of this meeting, I should express, as representing you, our satisfaction at the manner in which the Chairman and the Council have so kindly undertaken their duties and have maintained and kept up this Institution. We have expressed, through a Resolution, a vote of thanks to those Members who are leaving the Council; but I think it is due to those who still remain that their services should not pass unnoticed. I conclude by expressing my own personal feeling that whatever I can do, or the Admiralty can do, to support this Institution or increase its usefulness, we shall be very glad to do.

Admiral Sir Henry Codrington, K.C.B.:—

I have pleasure in rising to propose the thanks of this Meeting to the gallant officer who has done us the honour of presiding on this occasion. There are few people, except those, perhaps, who have been initiated within the Admiralty walls, who know how hard the work is, that goes on there, and how the time of the officials is occupied, not only all day, but sometimes very far into the night, so that really it is a somewhat serious thing when they are called upon to do other duties elsewhere. Our thanks, therefore, are due to those members of the Government who, from time to time, give us the support of their presence in the Chair at our Meetings. I think we may also add something on our own behalf. This Institution does a great deal of good in return for the kindness we experience from those who are at the heads of our two Departments. We owe much to them for their kindness, and for the assistance which they give us in various ways; and certainly we owe them a great deal for the interest they have shown in this Institution. I must, however, say for the Institution, that, as far as we can, we have done our utmost to show our sense of that. We perform a very useful part towards them. Their time is so much occupied, that they cannot go into all the new inventions and into all the new proposals put before them, whether of a military or of a naval character; but here, in this Institution, these things are thoroughly examined and discussed, and gentlemen at the heads of the two Departments have the opportunity of obtaining a clear knowledge of those subjects beforehand without having had the trouble of personal interviews with inventors. Everybody who has been in office knows perfectly well what a very onerous task it is to see inventors, and to have to decide between a great number of inventions when public business presses elsewhere. Therefore, I think, we may fairly say that we on our part have done our utmost to do our duty towards the Administration without any respect of parties, of which we know nothing here. At the same time I think we also feel we owe a very great debt of gratitude to those who preside over the two Services, and especially, I may say, to the gallant officer who on this occasion has (not for the first time) assisted us by his presence and his counsel.

General Spencer Stanhope:—

I have very great pleasure in seconding the vote proposed by the gallant Admiral. I am sure we are indebted to the gallant Admiral who has taken the

Chair so unexpectedly as he was called upon to-day to do; and the way in which he has performed his duty has, I am sure, been agreeable to us all. I beg to second the Resolution.

The Resolution was carried by acclamation.

The CHAIRMAN:—

I am exceedingly obliged to you for the kind manner in which you have mentioned my name. My only wish has been to do all that I can for the Institution, and I certainly regret that my friend, Mr. Hunt, who would have filled the Chair certainly much better than I can, was not here himself. I beg to return you my best thanks.

NAMES OF MEMBERS

WHO JOINED THE INSTITUTION BETWEEN THE 28TH JUNE AND 31ST DECEMBER, 1875.

LIFE.

Stuart, William, Lieut.-Col. Bedford Militia.
Weld, Frederick A., Esq., Governor of Tasmania.
Paget, Harold, Lieut. 7th Hussars.
Blake, Wm. G., Capt. 3rd West York Militia.
Archer, G. W., Capt. Royal Engineers.
Kennedy, J. Douglas, Capt. 6th Royal Lancashire Militia.
Burke, W. St. George, Capt. Royal Engineers.
Gibbings, Henry Cornwall C., Sub-Lieut. 108th Regiment.
Loyd, A. P.. Lieut. 21st Hussars.
Gill, W. J., Lieut. Royal Engineers.
Bland, F. Maltby, Esq., late Mid. R.N.
Fergusson, R. C., Lieut. Scots Fusilier Guards.
Astley, F. D., Lieut. Scots Fus. Guards.

ANNUAL.

Higginson, C. F. M., Capt. 2nd Bengal Cavalry.
McDougall, Neil, Esq., Control Department of the Navy.
Lawley, Hon. R. N., Capt. late 2nd Life Guards.
Morgan, G. B., Major late 77th Regt.
Harvey, John E. A., Lieut. 42nd Highlanders.
Edridge, F. L., Major 20th Regiment.
Whitehorne, A. H., Lieut. Roy. Artillery.
Rose, H. Cooper, M.D., Surgeon Royal East Middlesex Militia.
De la Voye, Alex. M., Lieut. 56th Regt.
Cox, Talbot A., Lieut.-Col. 3rd Buffs.
Williams, D. W., Lieut.-Col. Madras Staff Corps.
Howard, H. R., Capt. 3rd Herts Rifle Volunteers.
Eden, H. H., Capt. 30th Regiment.
Harford, F. Lloyd, Lieut. 36th Regt.
Westby, B. C., Capt. 16th Regiment.
Wildman, C. W., Capt. 87th Regiment.
Childers, E. W., Lieut.-Col. Royal Artillery.
Jackson, James B., Capt. 21st R.N.B. Fusiliers.
Vyvyan, G. R., Lieut. R.N.R.
Gore, G. R. C. Ormsby, Lieut. Coldstream Guards.
Stopford, Horace R., Lieut. Coldstream Guards.
Philpot, Harvey J., Surgeon late Brecon Militia.
Barnell, H. D. H., Lieut. Scots Fusilier Guards.
Collins, F., M.D., Surgeon-Major Army Medical Department.
Lloyd, R. O., Lieut. Royal Engineers.
Holland, A. G., Lieut. 15th Hussars.
Blackett, C. F., Capt. Rifle Brigade.
Preston, F. W. H., Lieut. 49th Middlesex Rifle Volunteers.
Meryon, J. E., Lieut. R.N.
Fraser, Hon. H. T., Lieut.-Col. Scots Fusilier Guards.
Travers, E. A., Sub-Lieut., Unatt.
Vernon, Hon. G. W. H., Lieut. Scots Fusilier Guards.

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Knollys, H., Capt. R.A.
Owen, C. H., Lieut.-Col. R.A.
Milman, G. H. L., Maj.-Genl. R.A.
Hime, H. W. L., Capt. R.A.
De Butts, J. C. B., Col. R.E.
Drake, J. M. C., Major R.E.
Harrison, R., Lieut.-Col. R.E.
Innes, J. McLeod, V.C., Lieut.-Col. R.E.
Jones, Jenkin, Col. R.E.
Smith, P. G. L., Major R.E.
Stotherd, R.H., Lt.-Col. R.E.
Rowcroft, H. C., Lt. R.E.
Woodward, C., Capt. R E.
Gun, H., Capt. R.E.
Earle, W., Col. 1 Batt. Grenadier Guards
Hinchingbrook, Viscount, Lieut.-Col 3 Batt. Gren. Gds.
Barton, R., Capt. 1 Battalion Coldstream Gds.
Trefusis, Hon. W. R., Lieutenant-Colonel 1 Battalion Scots Fusilier Guards
Moncrieff, G. H., Lt.-Col. 1 Batt. Scots Fus. Gds.
Fletcher, H. C., Col. C.M G., 2nd Batt. Scots Fusilier Guards
MccGwire, E. T. St. L., Col. 1st Batt The Royal Scots
Colley, G. Pomeroy, C.B., Lt.-Col., 2nd Batt. 2nd Queen's Royals
Mackinnon, W. C., Capt. 1st Batt. 3rd the Buffs
Pearson, C. K., Lieut.-Col. 2 Batt. 3rd the Buffs
Cameron, W. G., C.B., Col. 1 Batt. 4th K.'s Own
Yorke, P. C., Lt., 2nd Batt. 4th King's Own
Bigge, T. S., Lieut.-Col. 1 Batt. 5th Fusiliers
Ross, A. E., Major, 2nd Batt. 5th Fusiliers
Cockburn, J. G., Capt. 1st Batt. 6th Regt.
Plummer, H., Major 1st. Batt. 7th Royal Fusiliers
Waller, G. H., Lt.-Col. 1 Batt. 7th Royal Fusiliers
Daubeny, A. G., Major, 1 Batt. 7th Royal Fusiliers
Brown, C. R., Capt. 2nd Batt. 8th King's Own
Glen, A., Lt. 2nd Batt. 10th Regt.
Hare, E. H., Capt. 1 Batt. 11th Regt.
Colvile, C. F., Capt. 2d Batt. 11th Regt.
Parr, H. H., Lieut. 1st. Batt. 13th Light Inf.
Hawley, W. H., Lt.-Col. 1st Batt 14th Regt.
Layard, C.E., Cap. 2 Batt. 15th Regt.
Stone, C. P., Capt. 1 Batt. 15th Regt.
Bancroft, W. C., Col. 2 Batt. 16th Regt.
Tompson, W. D., Major 1 Batt. 17th Regt.
Griffiths, E. St. J., Major 1st Batt. 19th Regt.
Knight, H. S. G. S., Major 2nd Batt. 19th Regt.
Jackson, F. G., Capt. 1st Batt. 21st R. N. B. Fus.
Browne, Edm. C. Capt., 2nd Batt., 21st R N B. Fus.
Panter, H. G, Lt.-Col. 2 Batt. 22nd Regt.
Creek, E. S., Capt., 1 Batt. 23rd Royal Welsh Fusiliers.
Terry, F. S., Major 2nd Batt. 25th Regt.
Hale, M. H., Major 26th Regt.
Barton, E., Lieut., 27th Regt.
Brodigan, F., Major 28th Regt.
Spratt, E. J. H., Lieut. and Adjt. 29th Regt.
Bateman, H. W., Capt. 31st Regt.
Swiney, G. Clayton, Capt. 32nd Regt.
Lloyd, T., Capt. 35th Regt.
Elles, W. K., Major 38th Regt.
East, Cecil J., Bt., Major 41st Rt.
Martin, G. W. T., Lt. 46th Regt.
Rawlins, J., Major 48th Regt.
Lock, A. C. K., Lt.-Col. 50th Regt.
Farrington, M. C., Major 51st Regt.
Fife, A. G., Lieutenant 53rd Regt.
Parker, F. G. S., Major 54th Regt.
Barrow, Knapp, Capt. 57th Regt.
Frampton, W. J., Capt. 58th Regt.
Gunter, E. Capt., 59th Foot.
Riddell, H. S. Hutton, Lt. 1st Battn. 60th Royal Rifles
Chalmer, R., Capt. 2nd Batt. 60th Royal Rifles
Murray, O. Wyndham, Lt. 61st Rgt.
Brown, H. R., Col. 63rd Regt.
Barker, G. D., Lt.-Col. 64th Regt.
Blewitt, C., Lt.-Col. 65th Regt.
Ready, J. T., Capt. 66th Regt.

Lamprey, Jones, M.B., Surgeon-Major 67th Regt.
Bagot, Gilbard, G., Col. 69th Regt.
Gilbard, G. J., Capt. 71st Regt.
Payn, W., C.B., Col. 72nd Regt
Cornish, C. O., Capt. 73rd Regt.
Feilden, O. B., Major 78th Highlanders
Burroughs, C. A. P., Lt. 82nd Regt.
Beazley, G. G., Capt. 83rd Regt.
Wilson, W. H., Capt. 87th Regt.
Wood, H. Evelyn, V.C., C.B., Colonel 90th L.I.
Kirk, J. B., Major 91st Highlanders
Knollys, W. W., Major 93rd Highlanders. F.R.G S.
Malthus, S., Major 94th Regt.
Petrie, M., Major h.-p. 97th Regt.
Dunne, J. H., Col. 99th Regt.
Cook, H., Lt.-Col. 100th Regt.
Hunter, S. A., Capt. 101st Roy. Beng. Fus.
Rogers, J. E. V., Capt. 102nd Roy. Madras Fusiliers
Thornton, E. Z., Capt. 104th Regt.
Bell, H. J., Major 105th Madras Light Infantry
Garlick, J.W., Capt. 106th Bombay Light Inf.
Playfair, W. M., Capt. 107th Regt.
Fyers, W. A., C.B., Col., late Rif. Brig.
Maclean, H. J., Lt.-Col. 3rd Batt. Rifle Brigade
Wood, H., Maj. 4th Batt. Rifle Brig.
Mildmay, H. A. St. J., Capt. 3rd Batt. Rifle Brig.
Brownrigg, H. S., 3rd Batt. Capt. Rifle Brigade
Bunbury, C. T., Major 1st Batt. Rifle Brigade.
Cole, W., Lt., 1st W. I. Regt.
Stoker, W. Beauchamp, Capt. 2nd W. I. Regt.
Meaden, J., Major, late Ceylon Rifles.
Halpin, R. C., Rev., M A., Chaplain to the Forces, and to H.R.H. The Duke of Cambridge, K.G.
Nason, J., Lieut.-Col. 32nd Brigade Depôt
Morgan, H., Major, Paym. 70th Brigade Depot
McDonald, A. M., Col. late 7th Depôt Batt., Winchester
Fonblanque, E. B. de, Dep. Controller, H.P.
Jones, A. S., V.C., Lt.-Col., late Adjutant Staff Coll., Sandhurst
Cox, J. W., C.B., Col. on Staff, Jamaica
Bolton, F. J., Major Unattached
Pole, C. V. N., Lt.-Col. Unattached
Davies, G. S., Major Unattached
Stewart, W. L., Col. Unattached
Yonge, G. N. K. A., Colonel Unattached
Layard, B. V., Capt. late 3d W.I. Regt.
Walkey, R., Capt. R.A., Instructor of Artillery, Royal Mil.Academy
Stoney, F. S., Capt. R.A., Assist.-Superintendent Royal Gun Factories, Woolwich
Doorly, M., Maj., late 1st W. I. Regt.
Strange, T. Bland, Lt.-Col. R.A., Special Duty, Canada
Heathorn, T. B., Capt., late R.A.
Macaulay, G. W., Lt.-Col., late Comt. 1st Scinde Horse
MacGregor, H. G., Capt. 29th Regt., Garrison Instr., Home District
Robinson, C. W., Major Rifle Brig., Major of Brigade, Aldershot
Fawcett, R. H., Captain 33rd Foot, Garrison Instructor, Curragh
Hale, L. A., Major R.E., S.M.E., Chatham
Roe, Eugene M., Captain R. W. Fusiliers, Garrison Instructor, Shorncliffe
Savile, A. R., Capt 18th Rl. Irish, Garrison Instructor, Dover.
Walton, C. E., Dep. Com.
Morton, G. de C., Capt., A.D.C. to the Lt.-Gov., Punjaub
Hozier, J. W., Capt. Scots Greys, D.A.Q.M.G., Intelligence Dept.
Rogers, E., Capt. Staff Officer of Pensioners, Chester, F.R.G.S.
Wright, A. F. Bingham, Captain, A.D.C. to Brig. Gen. Comdg., Chatham
Willoughby-Osborne, Eric, Lt. h.-p.
Robertson-Ross, P., C.B., Col. 9th Brig. Depot
Thompson, R. T., Capt. 56th Regt. D.A.A.G., Aldershot
Marsden, W., Capt. 82nd Regt., D.A.A.G., Portsmouth
Goldsworthy, W. T., Lt.-Col., A.A.G., Cork
Travers, E. A., Sub-Lieut. Unattached R.M.C., Sandhurst.
Bulger, G. E., Lieut.-Col. late 10th Regt.

HER MAJESTY'S INDIAN FORCES.

Birch, W. B., Capt. Bengal Staff Corps
Fosbery, G. V., V.C., Lt. Col. Bengal Staff Corps
Sandeman, J. E., Capt. Bengal Staff Corps
Gordon, J. J H., Lt.-Col. Commandant 29th Bengal Native Infantry
Mouat, F. J., Deputy-Inspector-Gen. Ben. Army, F.R.C.S.
Lloyd, E., Lieutenant 4th Punjaub Cavalry
MacGregor, Lt.-Col. C. M., C.S.I., Assist. Quarter-Master-General, Army Head Quarters
Neave, E. S., Lieut. 18th Beng. Cav.
Grant, J. M., Lt.-Col. Madras Staff Corps
Bythell, R., Major, Fort Adjutant, Asseerghur
Ostrehan, E. S., Major Bom. Staff Corps
Watts, J. G., Major Bombay Staff Corps
Cologan, J. Fitzgerald, Captain Bengal S.C.
Sewell, H. Fane H., Capt. Hyderabad Contingent
Clutterbuck, T. St. Q., Capt. 29th Punjab Inf.
Prendergast, G. A., Major Comdt. 15th Bengal Cavalry
Heyland, A. Rowley, Capt. 1st Bombay Lancers
Collen, E. H. H., Capt. B.S.C., Officiating Assistant Sec. to the Govnt. of India, Military Dept.

MILITIA.

ENGLAND.

Brereton, Robert, Capt. and Adjt. Royal Brecon
White, C. H., Capt. and Adj. 1st Roy. Cheshire
Hall, G., Lieut.-Col. Durham (Artillery)
Tompson, H. Steuart, Capt. and Adjt. 2nd. Stafford
Digweed, W. H., Lt.-Col., late Hampshire
Campbell, J. R., Major Hampshire (Artillery)
Berthon, Alderson, Capt. Isle of Wight (Arty. Mil.)
Doughty, Chester, Capt. and Adj. Hereford
Bailey, Vincent, Capt. Hertford.
Perrott, Herbert C., Lieut. East Kent.
White, C. W., Lt. West Kent Light Infantry
Wilson, C. T., Capt. 7th Royal Lancashire
German, J., Major late 3rd Roy. Lancashire
Enfield, Viscount, Honorary Col. 2nd Roy. Rifles
Sewell, T. D., Capt. Royal London
Swan, J. P., Capt. Roy. Westminster, Middlesex
Parker, C. W., Capt. and Adjutant 4th Roy. South Middlesex
Northumberland, His Grace the Duke of, Lieut.-Col. Northumberland
Adair, A. W., Lieut.-Col. Commdt. 2nd Somerset
Macliver, D., late Capt. 2nd Somerset
Foster, Kingsley O., Capt. The (King's Own) 1st Stafford
Evelyn, G. P., Lt.-Col. Commandant 1st *Roy. Sur.*
Davis, John, Capt. *2nd Royal Surrey*
Allison, Jas. J., Col. N. Durham
Flower, L., Capt. 3rd Roy. Surrey, I. Musketry
Gage, The Hon. H. E H., Lieut.-Col. Royal Sussex
Lee, J. W., Captain Queen's Own Light Infantry
Norris, G. G., Capt. 2nd Warwick
Cockle, G., M.A., Cpt. Rl. Westmorland, I. Musketry
Fyers, H. T., Lieut.-Col. East and North York (Art.)
Wade, H. C., C.B., Col. North York Rifles
Raikes, G. A., Capt. 3rd West York
Cadman, W. E., Major 5th West York
Garnham, R. E. W., Major 6th West York.

SCOTLAND.

Hall, A. W., Capt. Royal Aberdeenshire Highldrs.
Walker, G. G., Lt.-Col. Scottish Borderers
Hardie, H. R., Capt. Haddington (Artillery)
Halkett, J. C. C., Lt.-Col., Stirling
Mackenzie, Colin, Capt. The Highland Rifle Militia

IRELAND.

Stawell, W. St. Leger Alcock, Lieut.-Col. North Cork (Rifles)
Duncan, P., Major West Cork (Artillery)
Forbes, Hon. W. F., Lt.-Col. Leitrim Rifles
Gort, Viscount, Hon. Col. Limerick City (Artillery)
Fox, L. Loftus B., Capt. Prince of Wales' Royal Longford Rifles
Caulfield, J. A., Lt.-Col. Royal Tyrone Fus.
Cuffe, O. W., Capt. and Adjt. Waterford (Artillery)

YEOMANRY CAVALRY.

Croft, R. B., Lieut. Herts., F.L.S., F.R.M.S.
Tottenham, C. J., Hon. Col. Denbighshire
Mildmay, Sir H. B. P. St. John, Bart., Lieut.-Col. Hampshire
Hamilton, J. G. C., Major Lanarkshire Q.O.
Portman, Hon. W. H. B., Col. West Somerset
Stanhope, W. T. S., Capt. 1st West York

HON. ARTILLERY COMPANY.

Field, J. W. P., Capt. I. Musketry

VOLUNTEER CORPS.

Artillery.

Butley, J. Lewis, Captain 2nd Middlesex
Innes, Alex., Major Aberdeen and Kincardine
Owen, R. G., Lieut. 3rd Essex
Pooley, H., Captain Cheshire
Haworth-Booth, B. B., Lieut.-Col. East Yorkshire

Engineers

Kain, G. J., Capt. Middlesex
Bailey, W., Capt. and Adjutant 2nd Tower Hamlets

Rifles.

Acland, Sir Thomas Dyke, Bart., M.P., Lieut.-Col. Devon
Davidson, D., Lieut.-Col. Edinburgh City
Twyford, H. R., Lieut.-Col. Hampshire
Hardinge, Viscount, Lieut.-Col. Kent
Sweny, Eugene, Capt. Kent.
Higgins, F., Major, 6th Lancashire
Hutchinson, J., Hon. Col. 8th Lancashire
Tomkins, A. S., Capt. 1st Middlesex Victorias
Vickers, C.B., Lt.-Col. 2nd London
Page, Sam. Flood, Major late London Scottish
Lombard, G. C. S., Capt. and Adj. 21st Middlesex
Baker, James, Major 22nd (Queen's) Westminster
Roupell, C. M., Capt. 23rd Inns of Court
Enfield, Viscount, Honorary Col. 29th Nrth. Midlsx.
Baylis, T. Henry, Major 36th Middlesex. Q.C.
Vincent, C. E. Howard, Lieut.-Col. 40th Middlesex, F.R.G.S.
Skrine, Harcourt, Capt. 43rd Middlesex
Walker, A., Capt. and Adjt. Northumberland
Wright, C. J., Lieut.-Col. Nottingham
Thomas, W. H., Capt. 1st Surrey
Dartmouth, Earl of, Capt. Stafford
Rouse, Rolla, Major late 2nd Suffolk
Harding Charles, Major 19th Surrey, F.R.G.S
Ratcliff, C., Lieut.-Col. 1st Warwickshire
Longstaff, Llewellyn W., Major 1st East York, F.R.G.S.

COLONIAL RESERVE FORCES.

Militia.

Gore, Augustus F., Lt.-Col., Barbadoes
Brunel, A., Lt.-Col., Active Militia. Canada
Turnbull, J. F., Colonel Canadian Hussars.
Imlack, R. W., Lt.-Col., British Guiana

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LECTURE.

Friday, January 31, 1875.

THE RIGHT HONOURABLE LORD LAWRENCE, G.C.B., G.C.S.I., in the Chair.

ON JOURNEYS BETWEEN HERAT AND KHIVA.

By Major-General SIR FREDERIC J. GOLDSMID, C.B., K.C.S.I.

THE late Lord Strangford, in an interesting and elaborate paper on Vambéry's Travels in Central Asia, contributed nearly ten years ago to the *Quarterly Review*, brings prominently to notice the fact that Independent Turkistan, or the region of the three Khanates of Khokand, Bokhara, and Khiva, was only practically accessible to the non-accredited traveller from Western Europe, on the southern side. Referring to the approach from that quarter, he states that of the Afghan routes the principal is that of Herat, converging with the Persian route from Mashhad at Marv. I propose to consider the information we find readily available on this important section of the Central Asian Map; not because it involves any very new features of political or physical geography, but because it seems to have been more or less ignored in the last two years' discussions arising from an unusually direct, and, moreover, a somewhat remarkable move of Russian diplomacy.

The journeys of Abbott and Shakespeare naturally present themselves as affording the latest and most reliable data for the purpose just stated. When they were undertaken, the politics of Central Asia had suddenly become of the deepest interest to those Englishmen who understood them; of passing perplexity to those who, without full comprehension of their import, were responsible for the course pursued by this country in regard to them; but were, upon the whole, rather *caviare* than strictly congenial to the taste of the general public.

In these days, although the interest aroused at home in Central Asia

falls far short of the great importance of the theme, and seems really to owe its sustentation at all to startling telegrams, a sensational article or volume, a speech in or out of Parliament, or a Shah's visit, there is certainly no lack of materials stored together in our libraries and Institutions to ground, as well as to coach a tyro into a respectable Oriental diplomatist; and to this common stock were there but added the contents of official shelves and official map-rooms, I believe that England could now show the world as much true and trustworthy information on the political and physical geography of the Khanates and Chinese Turkistan, as well as on Persia, Afghanistan, and Baluchistan, as is possessed by any nation in the world, not excepting Russia. Were it worth while, as it may some day be thought, for Government to organise a separate department of men and *matériel* for the conduct and development of its Asiatic relations, exclusive of British India and British Colonial possessions, but inclusive of Turkey, Arabia, and Persia, perhaps also of China and Japan, we might have a school of administrators and executives, if not superior to all existing continental establishments, at least not inferior to any. That a consummation so devoutly to be wished, can be attained without the pains and expense of separate organisation, or without borrowing an idea from contemporary foreign practice, is to me problematical. But we may take a hint from our neighbours without servile imitation; and improvement and modification may be freely exercised on the models with which they supply us.

A quarter of a century ago, about the period to which I have already reverted, able politicians and excellent explorers were to be found in the Indian services: men ready to devote their lives to the State with a loyalty worthy of more consideration than measured out by bare results in the form of success or failure. Alexander Burnes, Arthur Conolly, Leech, Lord, and Oxus Wood were types of the class; one, whose members, though not all professional soldiers, were, without exception, actuated by a soldierly spirit. Travellers of this stamp, making light of the barriers of the Hindu Kush and its offshoots, eagerly emerged upon a new scene, and strong in civilized energy and ambition, descended upon the little-explored regions before them to gather to their country's honour as their own, rich fruits of interesting knowledge for the benefit of coming, as of present generations. In the years 1839–40, this irruption of enterprising emissaries from India reached its climax; and it can hardly be supposed that the great Power overhanging the Central Asian belt on the North could remain passively contemplating the action of a rival European Power, which, having under Providence become possessed of an Empire in the far East, was utilizing the resources of that distant possession, after so practical a fashion, close to its own doors. Hence must be attributed the counter-movement which, though it may not be said to have caused, may be fairly held to have hastened the past annexation of land, and more thorough absorption of power in the no longer Independent Khanates. So rapid has been progress in this direction that Khiva and Bokhara have already suffered territorial confiscation, and Khokand is clenched as in a vice. Our explorers have now not far to go

beyond the limits of the Hindu Kush, to find themselves on Russian soil. It is not our business in this place to inquire into the advantages or disadvantages of a state of things not by any means abnormal, nor contrary to the precedents of Time and natural development. We have to congratulate ourselves on at least one mission during the past year, which has broken ground in a most interesting quarter, and brought home information on the political and physical geography of Eastern Turkistan and the Pamir Steppe or valleys, as well as other scientific results of well-conducted research. And if we have no recent similar missions to credit to England over the regions lying between the Tian-Shan mountains and the Caspian, we may find consolation in the fact that a British Officer has been permitted to accompany the Russian Expedition, which in the past summer commenced exploring the mouths of the Oxus with a view of perfecting as much as possible the water communication so essential to the security of Russian interests in Turkistan. Major Herbert Wood is working under different conditions from those which influenced his eminent namesake, Lieutenant John Wood of the Indian Navy; but there is no reason why good utilitarian service should not be rendered at the outlet as at the source of the ancient river.

Missions of Abbott and Shakespeare, 1840.—Before entering upon the practical business of the present paper, I will say a few words on the Officers whose routes we are about to retrace. Missions to Persia and the neighbouring tracts are not sufficiently popular to be well known and understood in England on their merits alone. They require the newspaper paragraph, the publisher's advertisement, and last not least the temper and character of the times to support them; for without such significant aid they are weighed and judged within the official world which is their birth place; and beyond the circle of that world they have no real existence. In the case referred to, the publisher has not been wanting, but interest in the theme treated, has flickered and failed, and its revival has been at an hour when later journeys and incidents are in demand. If I endeavour to deal with the matter briefly, it is simply because my explanation must be of the nature of a preface.

Major-General James Abbott, C.B.—Captain James Abbott of the Bengal Artillery was at Herat in 1839, when Major D'Arcy Todd, of the same corps, had entered upon the duties of Envoy at that important place, in the face of difficulties compared to which the settlement of an Alabama question would be clover and child's play. Among other proceedings due to the circumstances of the day, the latter Officer managed to open communications with the Khan of Khiva, who responded to the friendly messages of the British by despatching an Ambassador from himself to the Indian Government. As might have been anticipated, the demands of the Kharizmians were more than could be complied with; but in place of a disappointing letter, Captain Abbott was deputed to visit their capital in person. At Khiva there was considerable commotion, for it was the period when

General Perovsky, with a large force, was endeavouring to invade the Khan's territory from Orenburg and Fort Emba, by a route west of the Aral Sea. The reasons for entering upon a campaign of so physically difficult and so morally disturbing a nature have long been made public. Insufficient compensation for the capture and enslavement of Russian prisoners by Turkmans had been obtained in the counter-capture of Khivan subjects; and a succession of unsatisfactory missions and minor expeditions had finally culminated in the formation of a somewhat formidable Russian Army of invasion. After a long detention and several interviews with his royal but uncivilised entertainer, Abbott was induced to proceed, on the potentate's behalf, in the direction of the advancing Northern foe; but on reaching the shores of the Caspian, he was attacked, plundered, and otherwise ill-treated by Kazaks or Kirgiz, narrowly escaping with his life and losing two of his fingers. Those who have not read the narrative of a "Journey from Herat to Khiva, Moscow, and St. Petersburgh," will do well to procure the book and trace in it the adventures of this gallant Officer through months of peril and anxiety.

The late Colonel Sir Richmond Shakespeare.—An account of Lieutenant Shakespeare's journey is to be found in "Blackwood's Magazine" for June, 1842, in which month the writer was fulfilling the duties of Military Secretary to Sir George Pollock, who had halted with his Army at Jalálabad, on the high road to Kabul. This same Officer, also an artilleryman, was chosen, it will be remembered, on the occasion of the British advance into Afghanistan in 1839, to accompany Major D'Arcy Todd when detached to Herat on political employ. From Herat he was dispatched to Khiva in 1840—some five months after Captain Abbott's departure in the same direction—to complete the negotiations which his brother Officer and immediate predecessor had commenced for the release of Russian captives, and his efforts in the cause were so far successful that he was enabled to escort a large body of these men to their native country. Whether or no the collection and registration of the party by the Russian Cornet Aitoff, also a prisoner in the Khan's hands, be taken into account in estimating the share of merit to be accorded to each actor in the drama, our verdict must be passed on the actual duty intrusted to the British Officer, and the mode of its fulfilment; and we can surely affirm that the political utility of the proceeding was no more conspicuous than its practical philanthropy. It is not easy for all practised travellers, much less for worthy citizens of London who seldom quit their own firesides, to appreciate fitly the service rendered by a fellow-countryman in escorting 416 human beings of exceptional type from Khiva to Novo Alexandrovsk, across the Ust Urt; but it was a feat well worthy of record. On the 1st October he handed over his charge to the Russian Governor at Orenburg; at St. Petersburgh, in November, he received the personal thanks of the Emperor for his labours; and he soon afterwards reached England, to return to India in 1841 with a well-earned knighthood.

As regards Sir Richmond Shakespeare's after career, I will quote a

passage from a remarkable article by Mr. Henry Lushington, reprinted some 30 years ago, with other papers, in a small octavo volume, under the title of "A Great Country's Little Wars." The author is treating of the relief of the British captives on the re-occupation of Cabul:—

"The principal immediate agent in their recovery was, appropriately, "the same English Officer whose name was previously known as con- "nected with a service to humanity more free from alloy, more purely "gratifying, than it can have often fallen to the lot of a military man "to effect—the rescue and safe conduct to St. Petersburgh of the "prisoners detained at Khiva. Sir Richmond Shakespeare, to whose "lot two such services have fallen, is indeed a man to be envied."

Sir Vincent Eyre also speaking of that memorable month of September, 1842, says:—

"On the 17th we were reinforced by Sir R. Shakespeare, who had "ridden out from Kabul with 600 Kizlbash horsemen, to our assist- "ance. His aid was most timely; for Sultan Muhammad Khan, with "1,000 men, was hastening to intercept us."

General Perovsky's narrative, written many years after these missions had been accomplished, while ignoring aught but political objects in the whole proceeding, confirms at least the arduous and adventurous character of the duties undertaken:—

"The English Agents," he states, "who were in central Asia during "the years 1839 and 1840, were Abbott and Shakespeare. In May, "1840, Captain Abbott, of the East India Company's service, reached "Novo-Alexandrovsk Fortress from Khiva, and proceeded thence to "Orenburg. * * * * By the order of the Khan he was robbed "and wounded on his route to the Caspian by a gang of Turkmans "(who had even been instructed by the Khivans to kill him), and from "Orenburg he was sent in a suitable manner to Petersburgh, whilst the "Afghans that had accompanied him were sent back to their native "country. Shakespeare, the other English Officer, reached Orenburg, "*viâ* Novo Alexandrovsk, with the Russian prisoners who had been "released from Khiva; he was immediately sent on to St. Peters- "burgh."

Oxus Route.—If we take routes actually traversed, with deviations and *détours*, the distance from Herat to Khiva, by the Oxus, may be reckoned roughly at a maximum of 700 miles. Of this route, the two *termini* and the intervening station of Marv, about 430 miles from Khiva, are really the only places which demand especial notice among centres of population. As the crow flies, the whole distance is less than 600,[1] or, according to one estimate,[2] little more than 500 miles; and Marv is nearly midway. Indeed, some modern geographers attribute the commercial importance of Marv to the circumstance that it "lies almost "in the centre of a region bounded by five large markets, Khiva, "Urganj, Bukhára, Balkh, and Herat, being 180 to 280 miles distant "from each" (Ritter). Mashhad, the capital of Russian Khurasan,

[1] Abbott makes it less by his own route.
[2] Markham. History of Persia. Appendix D.

might have been added on the S.W. as an important city within the specified limits.

Herat.—Herat has been often described. In reverting to it we need not go back to the classical period, or even to the Arabic and Persian geographers, though materials are ample in both respects. During the present century Christie is its earliest English visitor; but Forster preceded him by 27 years, or in 1783. Arthur Conolly, a hero in life as a martyr in death, was there in 1830. His Persian attire did not divest him of his English personality, and his name and nationality were known to Shah Kamrán. From Eldred Pottinger's arrival there in 1837, until Todd's departure in 1841, it was the open abode, as well as halting-place, of many British Officers. After the latter year, less direct and trustworthy information on the locality has been at the disposal of Her Majesty's Government, if we except that obtained by Colonel Taylor's mission in 1857, and by Colonel (now Sir Lewis) Pelly in 1860. But Ferrier, travelling in 1845, Khanikoff in 1858, and Vambéry in 1863, have published most interesting particulars of this much extolled city, its inhabitants, and surroundings; and to these writers the general public is greatly indebted for the readiness and ability with which they have utilized their labours in print. From the sources named, there is no difficulty in depicting the "Heri" of the present day within the bounds necessary to be observed in an ordinary lecture.

The word "júlgah" is commonly applied in the East of Persia to the large tracts of low level ground in a hilly country, lying between long ranges, parts of one mountain system. These, being rather plains than valleys, riverless, but watered from the overhanging mountains, are in some cases fairly fertile; in others partially so; in others almost desert. The large district of Káian, on the Káianát, S.W. of the Siah-kuh range, through which I passed when returning from Sistan in 1872, affords a full illustration of my meaning. Now, the valley in which Herat is situated, inclusive of the surrounding plain, is of the most fertile class, and, unlike the ordinary Persian "júlgah," is rich in the possession of a river. Its length, from east to west, is put down at 30 miles. It is about 16 miles in breadth, exclusive of the ground taken up by the fortress and walls: four of these miles separate the town from the northern, and twelve from the southern hills, while at one quarter of the latter distance runs the Heri-rúd, or Herat river, which, rising near the Kuh-i-Baba, pursues a westerly course till, passing its namesake city, it sweeps, first gradually, then decidedly, to the north, eventually to expend itself or lose its distinctiveness in the environs of Sarakhs. But the later progress of this river, both in its junction with the Tejend, and separate diffusion, has yet to be clearly traced. It presents a feature of political as of geographical interest; for it passes between the Persian and Afghan frontier-posts of Kahriz and Kúsún respectively, and may therefore be considered to mark the Perso-Afghan boundary at the Western Paropamisus.

Striking an average between conflicting measurements and otherwise carefully weighing the data before us, I think we may accept a descrip-

tion of the city of Herat which makes it of a rectangular and nearly square form; set almost exactly after the cardinal points of the compass, the faces from north to south being somewhat longer than those from east to west, but all from 1,400 to 1,500 yards. The walls, from 24 to 20 feet high, are built on an earthern rampart of about double their own height. A deep wet ditch which surrounds the whole is supplied, according to Conolly, by springs within itself. More recent information, on the other hand, assumes it to be filled by canals outside the walls, and in such case the supply might be cut off by an enterprising invader. But M. Khanikoff mentions a more palpable obstacle to effectual defence in the existence, at the north-east angle of the walls, and at about 700 yards distance from the bastion, of a broad-crested hill, overlooking the town, and covered with solid buildings easily convertible into batteries. A *mamelon* of this description could hardly fail to attract the attention of an enemy even moderately skilled in the science of sieges. The "Ark," or citadel, is behind the main wall of the northern face. The "Ark-i-Náo," or new citadel, however, intervenes and overlaps the older building. There are five gates, two on the north and one at each of the other faces. A high street traverses the town from the north-west to the south gate, and is the great centre of traffic. The population has been estimated at various figures. Some of these are doubtless erroneous. Others, though inapplicable to the present day, may have been tolerably correct at the time they were recorded: for the political revolutions of Herat have been continual, and must have had sensible influence on the numbers and character of the inhabitants. I do not think that 50,000 can be a very unfair or inexact supposition for the population under the Amir Sher Ali. Such a total would certainly be attained if Yakub Khan or his successor could add the element of stability to successful government. Conolly, who reckoned the number of inhabitants at 45,000, added that there were 4,000 dwelling-houses, 1,200 shops, and 17 caravanserais. As the first reply to his enquiries on the spot had elicited the statement that there were 12,000 houses within the walls, it is not impossible that the reduction to less than half the figure is under the true mark. In either case, the estimate of occupants would seem to be quite sufficiently high for the occasion. The mosque, the domed reservoir, the palace of the Chhár Bagh, and, it may be, the bazaar, and one or two of the larger caravanserais may be named among the more notable monuments of Herat; and if we go beyond the walls, with these may be included the ruins on the Musalla, or place of prayer, and the tombs of the Muhammadan saint, Khájah Abdullah Ansari, and Dost Muhammad Khan.

In 1830, Conolly was of opinion that the city was "one of the " dirtiest in the world. Many of the small streets," he wrote, " which " branch from the main ones, are built over and form low, dark " tunnels, containing every offensive thing. No drain having been " contrived to carry off the rain which falls within the walls, it collects " and stagnates in ponds which are dug in different parts of the city. " The residents cast out the refuse of their houses into the streets, " and dead cats and dogs are commonly seen lying upon heaps of the " vilest filth."

Vambéry, 33 years afterwards, in the same year that the town fell into the hands of the Amir Dost Muhammad, who did not survive his triumph a full fortnight, gives a gloomy account of its appearance:— "The houses which we passed," he says, "the advanced walls, the "very gate, looked like a heap of rubbish. Near the latter, in the "inside of the city, is the Ark (citadel), having, from its elevation, "served as a mark for the Afghan artillery; it lies there blasted and "half demolished. The doors and windows have been stripped of "their woodwork, for during the siege the inhabitants suffered most "from the scarcity of fuel. In the bare openings of the wall are "perched here and there a few wretched-looking Afghans or Hindus, "worthy guards of such a ruin. Each step we advance we see greater "indications of devastation. Entire quarters of the town remain "solitary and abandoned. The bazaar * * * * alone remains." He furnishes, however, a pleasant sketch of the inhabitants, here—as at Constantinople and Alexandria, Baghdad and Bombay—characterised by diversity of races; for there are Afghans, Indians, Tartars, Turkmans, Persians, and Jews.

Whatever objections on the score of outward appearances may arise in contemplation of the town, all travellers agree in commending the beauty and fertility of the Herat valley, said to be capable of affording supplies to 150,000 men. Independently of the immense natural advantages of a river, man has not been idle in the improvement and extension of cultivation by artificial means. Irrigation has been carried on to a considerable extent. The plain south of the walls is watered by a network of eight or nine large and many minor canals. The aqueducts are stated to be superior to those of Bukhara, Samarkand, and Ispahan. The grain produced is abundant; beyond the requirements of town and suburbs together. The bread, the water, the vines, have the credit of special excellence. Yet with all this wealth of means and material, much of the legacy of past ages is disregarded and nullified by the supineness of a present generation. The ruins visible on all sides are not of useless or obsolete works. As one conclusive instance may be cited the neglected "Púl-i-Malan." This bridge of 23 arches can scarcely be considered void of purpose or practical benefit. It is, however, rapidly falling into decay; and as the river has changed its bed, part of it remains barren of object on dry land. On the rising of the waters this state of things is most inconvenient; for the river is at such time no longer fordable, and the Kandahar caravans going to and fro have difficulty in crossing.

Khanikoff on British Commercial Relations with Central Asia, 1858–62. —On the commercial importance of Herat the testimony of Khanikoff is worth noting, whatever the value to be attached to it for present exigencies. In his work, published in 1862, he represented it a centre for all the main routes of Central Asia in an easterly and westerly direction; alleging that since the Marv Turkmans had closed the communications between Transoxiana and Khurasan, Bukhara goods must pass through Herat to reach Mashhad, paying duty at Balkh and Maimana, as well as at the former city. Notwithstanding the relations

with India, European merchandize reached Herat from the west, *viâ* Tehran, Indian caravans bringing only muslin and silk handkerchiefs, or silver for Hindu usurers, and taking back pistachios, gall nuts, and manna. He found, in short, European commerce in this quarter in a languishing condition, and was struck by a circumstance, already noted at Tabriz and Tehran, that our goods had almost wholly disappeared from the markets of Central Asia, where the English cloths had been replaced by German cloths and Swiss printed calicoes. French velvets, brocades, and jewellery were not in great demand, and Russia was disposing, here as elsewhere, of bar iron, cast iron, brass, steel, and such like, with the full confidence that the Caspian route would remain beyond the reach of all hurtful opposition, though strengthened by a completed network of Indian railways.

In coming now to the question of the road, I must apologise for a delay which would be unpardonable if our journey were from London, but is hardly irrelevant when the starting-point is in Afghanistan.

Abbott's and Shakespeare's Journeys.—Captain Abbott left Herat on Christmas Eve, 1839; Captain Shakespeare followed on the 4th of May, 1840, not five months afterwards. The former, besides his mirza or secretary and personal attendants, was accompanied by a relative of the Wazir Yar Muhammad, but was induced to rid himself of this comfortless escort on reaching the Khivan frontier. The latter was perhaps more fortunate in his assistants, and gives a good report of his Heráti Kádhi and son, besides a third Afghan, a gallant Indian irregular trooper, and others of his mixed suite. It must be borne in mind that these missions were conducted at a time when Central India was disturbed, not only by movements from Orenburg and the Caspian, but by rumours from an English camp which had pitched in the very heart of Afghanistan, unsettling men's minds and stirring up national jealousies and religious prejudices on either side the Hindu Kush.

Herat to Marv.—Both Abbott and Shakespeare made their first march to Parwánah, a village 11 miles north of Herat, reached by a good road rising through low hills. Hence, while Abbott was led, two marches off the direct road, to Khushk, the black-tented capital of the Jamshidis, Shakespeare appears to have pushed on in a straight course; first, for $12\frac{1}{2}$ miles, by a good easy road, to a handsome but spacious caravanserai,[1] old, but not quite a ruin; on the next day, for $45\frac{1}{2}$ miles, to a grassy spot on the banks of the Khushk river. Of the second march he describes the first 17 miles of the road as "truly beautiful," and estimates the elevation of the passage over the mountain crest at 7,000 feet. "There are hundreds of hills," he writes, "sloping off in "all directions, and covered with the most luxuriant grass; every "variety of colour was to be fóund in the weeds, and every little "valley had its own peculiar stream of the purest water." They afterwards met many black-tented "Khails" or nomad camps, with

[1] I learn from General Abbott that it must have been from this point that the two routes actually divaricated.—F. J. G.

cattle, but water was in places scarce. This was the district of "Bad Khyss," which I take to be "badkhiz," or the "wind arousing," an epithet obtained from the gullies or natural configuration of the country. I am unable to trace the precise locality of the third day's encampment in any published maps, but have placed it according to the distance and data given. The fourth march of Shakespeare's party was one of 30 miles, that is, 18 miles during the night and 12 after sunrise, for 9 miles "through the different little valleys close to "the banks of the Khushk," the remainder along the bed or banks of that rivulet. The fifth march of 44 miles, in two divisions of $6\frac{3}{4}$ hours night and $5\frac{1}{4}$ hours day, respectively, was to the Murghab River. The road traversed was generally good, but quicksands were observed in crossing the Khushk.

I have taken the word "Khushk," *dry*, as spelt by Abbott, in preference to Shakespeare's "Khush," *pleasant*, because it appears to be the more likely etymology; and it seems to me that the "Khushk Assaib," or rather "Khushk Asiáb, *dry water-mill*, of Ferrier's and Vambéry's maps cannot be far from the black tents already referred to as the capital of the Jamshidis. It was Ferrier's third march when going to Máimana. He makes it 7 parasangs, or about 25 miles from Khushk Ribát, and describes the road as "stony, across mountains and valleys, "and frequently cut up by torrents very dangerous to pass after heavy "rains." Abbott, disclaiming all intention to publish any particulars relative to the practicability or otherwise of the mountain chains he was traversing, speaks of "a high plain above Parwánah," whence he continued his route to the mountain ridge of Kaitú, "avoiding the "more direct and difficult passes." Having effected the passage without accident, he descended some grassy heights and pitched in a hollow; moving on, the next day, by a very distressing cross-country path, over steep hills covered with grass, to the Khushk rivulet, which he ascended to the so-called capital. Then passing this point, "down the valley of the stream, averaging about half a mile in width, "and bounded on either side by sloping grassy downs, sprinkled with "flocks of sheep and goats," he halted at a Jamshidi camp for the night. In the morning, resuming his course "down the valley," he came to a place called the "Chhahl Dukhtar," or *Forty Virgins*, and thence to "Kara Tepeh," or the *black mound*. Beyond this place the black tents were scarce, but large flocks of sheep were found. The shepherds came from Marv, "bringing," we are told,—and the statement is indicative of the local resources,—"water and all other necessaries "on asses."

From Kara Tepeh the party marched to a spot two miles short of a ruined castle designated "Kaláh Chaman-i-Bhayd." The last word should, I learn, be "Béd," or "Bíd," which would make the name intelligible as the "Fort of the meadow of Willows." Two castles succeed this, one "Kaláh Hauz-i-Khan," the Fort of the Khan's Reservoir; the other, beyond the Badkhiz, but in the Mauri district, called "the Fort of Maur." After this place commenced, at least in 1840, the kingdom of Kharizm, or more appropriately the Kleptarchy or Kleptocracy of the Turkmans. A reed jungle having served as

the night's camping ground, Abbott tracked hence the Khushk rivulet until its valley was lost in that of the Murgháb. We have now come upon one of the most important rivers of Central Asia south of the Oxus; rising in the Hazára mountains, or northern slopes of the Paropamisus, it flows in a north-westerly and northerly direction past the town of Marv, until it expends itself in a desert swamp.

How far Shakespeare and Abbott followed the same road, or at what point the former fell into the track of the latter it is hard to say; for Shakespeare mentions few places, and these few do not always agree with Abbott's. But it is tolerably certain that they both reached the Murgháb, by following the bed generally of the Khushk. Shakespeare gives no account of the junction of the two. Abbott is more precise, probably from having been the only traveller to whom ocular demonstration was allowed. When the two valleys became one, or near the apex where the two streams flow together, Abbott moved over from the right bank of the Khushk to the "Khail," or camp of Panjdeh, on the left bank of the Murgháb, "passing the ruined vine-"yard and deserted fields of a once populous and cultivated district." Here he found 300 black tents of nomads, in the form of two hollow squares. Proceeding along the left bank of the Murgháb until the valley had narrowed in breadth from nine miles to three-quarters of a mile, he crossed by a bridge the dry channel of the Khushk just at the point of junction. Hence to Marv, the route of both travellers must have been, more or less, along either bank of the Murghab; in fact, practically, to all intents and purposes, one and the same.

Shakespeare found the Murghab, on first acquaintance, "a muddy "rapid stream, the banks thickly fringed with tamarisk." During the night he moved twenty-two miles along its narrow, sand-hill enclosed valley, on a generally good road, with some steep sandy ascents, and abounding in wood and grass. Cultivation, however, had not been kept up as in the good old times, and as the fine soil would warrant. His next march after sunrise, during which he passed a place called "Sanduk Kuchan," I estimate at 24 miles, taking the figures wanting to fill the one gap in the whole recorded distance to Marv. The next night march was of 22 miles, still along the Murghab, and amid very heavy jungle, to near the "Band-i-Yalatun," or "bank which throws "the water of the Murghab into the canal of Yalatun;" an arrangement which had failed in that particular year, owing to a destructive flood. This was followed by a short march at sunrise, in oppressive heat, of 10 miles. The progress of the next night and morning, reckoned in one combined march of 27 miles, was to Yalatun, where was a Governor and *kadhi*. The same process repeated in the following twenty-four hours, for a total of 22 miles, brought the party to the fort and town of Marv.

Abbott's description of the Murghab shows it to be "a deep "stream of very pure water, about 60 feet in breadth, and flowing in "a channel, mined to the depth of 30 feet in the clay soil of the "valley; banks precipitous, and fringed with tamarisk and a few "reeds." The valley, once well cultivated, he found, from Panjdeh to Yalatun, utterly deserted, owing to late distractions of the country.

Pheasants, *chakors*, and rock-pigeon were abundant; and there were bears and panthers. At Yalatun "the desert aspect was a little broken "by symptoms of recent culture."

An excellent Russian scholar, Mr. Delmar Morgan, having kindly favoured me with translated extracts from Ritter's "Irán," just published in the Russian language, with annotations by M. Khanikoff, I take advantage of the occasion to notice what is there said of Marv. It may savour of insular self-satisfaction, but I think it quite legitimate, and it is undeniably pleasant to remark that, while English authorities are utilised wholesale in these valuable works thrown out, from day to day, by the Continental press, very little matter is brought to light which has heretofore been kept secret from our own writers and explorers. As compilations, these publications have an undeniable value; for they comprise the latest information obtainable on the particular subjects treated; and I could not fail to observe in the volume under reference, the map of Sistan, prepared from the data collected by an officer of my own mission in 1872. I am not now about to quote literally from Ritter; but his compilation gives me the substance of the following brief sketch.

Marv.—The plain of Marv, though now surrounded by deserts, has had from time immemorial, a reputation for fertility. According to Strabo, Antiochus Soter selected it as a site for one of the cities of Antioch, walling in, for the purpose, a space 1,500 stadia in circumference. Local tradition, on the other hand, takes the origin of the town a little further back, to Alexander the Great. Its ancient renown well accords with the consideration given to it by the Muhammadan Khalifs, and the testimony recorded in its favour by Ibn Haukal in the tenth century, not only for natural products of the soil, but for the learning of its inhabitants, progress in arts and sciences, and encouragement of commercial enterprise. No city had surpassed it in the grandeur of its palaces, the beauty and luxuriance of its meadows and gardens, and the abundance of its fresh water supply. Silk cultivation had been introduced thence into Tabaristan. Other towns sent to Marv to buy silkworms' eggs; while cotton and linen cloths of the finest quality were manufactured there. Two centuries later Edrisi writes that "the river flows past many beautiful houses "and populous villages or hamlets situated on its banks. The resi- "dences are an arrow's flight apart from each other, built of baked "clay, and surrounded with gardens." He praises the melons of Marv, its cotton, and the produce of its looms, remarkable for softness of texture, and eagerly sought by traders; and he names ten other towns, then visited by travellers, but now unknown, well supplied with water, and famed for the abundance of their fruits, their trade, their mosques, bazars, and caravanserais; thus proving how flourishing was the oasis of Marv at that particular epoch. In spite, however, of a brilliant early history, the city became a heap of ruins under the destructive inroads of the hordes of Jenghiz Khan; and though again rebuilt, and of considerable repute as a frontier city of Persia, was again laid waste in subsequent years. After the death of Nadir Shah, when

the frontier posts and outlying districts of Persia, if not strong enough to remain loyal or assert their independence, fell to the sword of the most powerful neighbour, Marv held out gallantly, under Bahram Ali Khan (and, according to Malcolm, under his son also), against its Uzbek invaders; but eventually it was subdued. A few words of literal quotation may here be added. "In 1787, Shah Murad, of "Bukhara, destroyed the canals and fortress, and removed the greater "number of inhabitants to his own city, where a separate community "of them still exists. The remaining inhabitants afterwards migrated "to Persia, and the oasis became a desert and camping-ground for "nomad Turkmans. The view from the fortress of Marv over the "surrounding district is desolate in the extreme. For a distance of "twelve hours' ride the ground is strewed with ruins of villages and "gardens, and with choked up meadows, exhibiting an occasional trace "of verdure wherever watered by river inundation. Fraser heard "that the only good building left was a mosque built by Taimur Shah, "some ruins of an extensive bazaar, and the tomb of an unnamed "warrior.[1] Even now the Turkmans gather, without the slightest "trouble, excellent wheat and delicious melons."

Ritter represents the Turkman possessors of modern Marv to be uncouth and illiterate robbers, fanatics without mosques, and more attached to their horses than fellow men. He adds that, in 1832, the Khan of Khiva marched with an army from Urganj to Marv to levy tribute from the Tekeh tribe; and that he established, both at Marv and Sarakhs (then in the hands of the Salors), custom-houses, in order to tax the goods carried by the caravan roads between Mashhad and Balkh. This information is derived from Burnes, who considered the advance of the Khivan troops creditable to the military genius of the Khan. The distance traversed, was fifteen marches, almost destitute of water, wells being dug from stage to stage. A vast herd of camels was employed conveying water and provisions; and of these, about 2,000 perished in the steppe. The Khan, Allah Kuli, commanded on this occasion in person. His father, Rahim Khan, had, however, performed a greater feat. He had entirely crossed the desert to Persia; but he had lost the greater portion of his horses in the undertaking, and was compelled to leave his guns in the sand. Vambéry mentions still later expeditions from Khiva to Marv; one in about 1842, when Medemin, or Muhammad Amin, brother of the then reigning Khan, moved at the head of 15,000 horsemen, against the Sarúk Turkmans; and six campaigns when the same chief, himself Khan, was opposed to the same enemy. The conqueror captured the citadel of Marv and the fort of Yalatun; but his triumph was of short duration; for no sooner had he returned to his capital than the Sarúks rebelled, and put the men, garrison, and commandant to the sword. Then followed a new campaign; and later still, three campaigns against the Tekehs, who, finally joining with the Yamuts, made themselves troublesome opponents. The Khan was killed by these refractory subjects near Marv, and his head sent as a present to the Shah of Persia.

Before commencing the upward journey to Kharizm and its capital,

[1] Probably Alp Arslan.

it may be well to note what Mr. Taylour Thomson writes with regard to Marv, from a visit paid in 1842. This gentleman was then on his way to Khiva from Tehran, *viá* Mashhad, Sarakhs, and the Oxus. He found the city, known to modern times as Marv Shah Jahan, and, to Persia especially, as one of the four great cities of Khurasan (Herat, Mashhad, and Nishapúr being the other three), "an assemblage of "wretched huts, commanded by a small mud fort, in which a Governor "of the Khan of Khiva resides, and defended by a few patereros and "swivel matchlocks." It had nothing to boast of but a small bazaar to supply the Sarúk and Salor tribes who frequented it. "Marv-i-Kajar," or Marv of the Kajárs (the present reigning dynasty in Persia), evidencing by its name that it is the last built of the four towns of Marv, was roofless; but its streets, walls of houses, mosques, and baths remained, a silent and gloomy record of the past. The Marv of the Seljukian dynasty was marked by low hillocks and a solitary tomb. Ancient Marv had been utterly effaced.

Marv to Khiva.—On leaving Marv, Abbott crossed a dry channel of the Murghab, and proceeded by a well-beaten road, in direction E.N.E. He soon observed to the east the ruins of a former Marv, of which a mosque and several forts were prominent features. The space covered by these remains of bygone prosperity appeared some thirty miles in circumference; so that it might well have included more than the city of the Persian kings. Rejoicing to quit a plain which, in his estimation, was "wretched, though much vaunted," and to which the desert was "a paradise in comparison," he mounted a lame horse, and proceeded in a direct route across the latter towards Khiva. Two return caravans, with slaves, were in company with his own party. One halt, probably the first, was at another "Kara Tepeh," where was a small "Khail," and a sluice of pure water from one of the canals. The next morning the march was resumed "over a plain" encumbered by sand hills, and sprinkled "with low jungle." The lower lands he found occasionally cultivated, with old watercourses and remains of habitations, speaking of a more prosperous period; the country, rather a wilderness than a desert, with abundance of dry firewood, and plenty of camel thorn, but no grass. As we are without detail of the marches of this party, Abbott's review of the ordinary day's procedure must be taken to supply the deficiency. He himself rose at midnight, and sitting at a blazing fire (for the supply of dry wood continued), and sipping tea without milk, awaited the loading and departure of the camels. Riding after and overtaking the latter, he alighted for half an hour, to spread his carpet at a new fire. He then mounted a second time, to proceed silently along a track not wide enough for two horsemen abreast, until day dawned upon the travellers, when they pulled up to get thawed and warmed again. By sunrise they had continued the march, and about ten they sought a convenient place for halting, sheltered from the wind, but exposed to the sun. Breakfast and a short sleep enabled them to resume operations, until about four o'clock, when the night's bivouac was to take effect. The cold was at times very severe. Icicles hung from the camel's beards; on one

occasion snow had fallen a foot in depth. Sand hills covered the surface of the ground; bushes of camel thorn were profusely scattered among the sand hills; nor were thickets of tamarisk wanting.

The greater part of the tract was stated to be safe to travellers provided with passes. But here and there caution was needed, such, for instance, as in the vicinity of a well about the fourth march, noted for forays from Derehgaz. One short passage may be extracted in the narrator's own words.

"The aspect of the desert, or rather wilderness, from Marv to Khiva " is that of a sandy plain, broken into the most irregular surface by " deep pits and high mounds, the whole thinly sprinkled with bushes " of three several kinds, between which grow wormwood and the camel " thorn. On approaching Khiva, the surface is often ploughed into " ravines and ridges, whose course is north and south, giving some " idea of abandoned watercourses, and traditionally reported to be old " channels of the Oxus. The ridges are gravelly, but there is no want " of sand. Wells on this route are found at long intervals, in one case " of 160 miles. The water is generally brackish, but there are excep- " tions. On approaching Khiva, there appeared a very thin sprinkling " of grass, which our horses eagerly devoured. But no dependence is " to be placed upon the pasture of this wilderness, and the traveller " must provide barley, or *jowári*, sufficient to supply the place of " fodder."

Shakespeare states that the regular road to Khiva crosses the River Murghab, close to the town. As the boat was injured, and the water was deep, he had to proceed in search of a ford. Abbott, on starting, crossed a dry channel. This apparent discrepancy may be attributed to the different conditions under which the two travelled, Abbott was at Marv in January, or the depth of winter, Shakespeare late in May, when the hot season had nearly set in. But there may be, and doubtless are, several branches of the Murghab conveying its waters to the desert below Marv, and some of these may take their rise above that place. Shakespeare's first march was of 12 miles to a Turkman khail, during which no river-crossing was effected. He afterwards moved in two marches of 16 and 17 miles, respectively, or 33 miles in the 24 hours, then only reaching *the River Murghab*, or, it may be fairly assumed, the main branch of the river. Marching the next morning along the bank for 15 miles, he crossed at an excellent ford, where the stream was about 30 yards wide, 3½ feet deep, and there was a hard bottom. In the evening he started again, intending to make a long march, but at 5 miles he came upon another stream with quicksands. In the morning a third stream met him at 4 miles, when he had difficulty in finding a good ford; and 15 miles further he found a fourth stream, nearly as large as the first, which detained him two hours. It is to be observed, therefore, that modern Marv, such as it is,—in all probability a miserable relic in its reality,—is on the left bank of a main branch of the Murghab; and that Shakespeare crossed that main branch at 60 miles, but did not clear the river wholly until 84 miles north of the town. We have not the recorded bearings, but as we know that the party were bound for Khiva *viá* the Oxus, and that they

moved "into the desert" at the point last specified, the general line of road may be fairly supposed.

Abbott, as we have shown, took the direct road, the road of the Khans of Khiva on their Marv expeditions. Shakespeare took the road by the Oxus. He tells us there are two; that called the "Rah-i-"Takht," or road of the throne, a common Oriental appellation of a flat-topped hill; and the "Rah-i-Chashmah," or road of the spring or fountain. He chose the former, and by it he reached the Oxus in seven days from the last crossing of the Murghab, and Khiva in seven days more from the time of coming up to the Oxus. The first section of the march, one of 165 miles, was a trying one, from heat and want of water; and the guides were perplexed in discovering wells and traffic tracks. Nor was the water, when obtained, always drinkable. The so-called desert was apparently made up of constantly recurring sand-hills and more abrupt mounds, with a lower surface swept over by shifting sand, and studded with dwarf bushes and wild vegetation. Bones of camels, and other signs of past toil and travel, scattered here and there, give little pleasurable relief to the eye of the new comer; but are sometimes useful as indicating a looked-for route. The Oxus was described as a magnificent stream, with rather high banks, and the distance from bank to bank at the point first reached, was estimated at three miles. The body of the water was carried in a serpentine course, now on one side, now on the other of the wide bed, leaving large portions of dry ground covered with luxuriant jungle. Its breadth varied from 300 to 500 yards. The second section of the march to Khiva was about 15 miles longer than the first. For 100 miles the route was chiefly along the bank of the Oxus: one diversion was into its very bed. The remainder was more to the westward, and in the heart of the Khivan country, its villages, and cultivation. The first village noted, since leaving Marv and the Murghab, was at eight miles before Fitnak, which, together with Hazarasp, is mentioned by Vambéry. and is generally found on maps of Khiva.

Mr. Taylour Thomson does not, that I am aware, say that he followed Shakespeare's footsteps from the Murghab to the Oxus; but he must have done so very nearly. He proceeds from Marv direct to the far-famed river; makes his distance thereto correspond closely with Shakespeare's, when clear of the Murghab; and though Shakespeare says nothing of the four intervening wells of Kishman, Yak-keper, Yandakli, and Sirtlanli, nor of Kabakli, perhaps questionably rendered the "pumpkin-ground;" he describes the Takht-i-Suliman, or throne of Solomon, "about 36 miles before reaching the Oxus;" which "Takht" is clearly the same as the so-designated sandhill of his predecessor. Shakespeare says, "the Turkmans believe that Solomon "paid it a visit," and calculates the distance thence to the Oxus to be 40¾ miles. The 4¾ miles in excess of the other account may be readily believed to comprehend a slight deviation of road or inaccuracy in rough computation.

Mr. Thomson writes: "At Deveh Boiún the cultivation begins, and "the road, leaving the river, branches off to the left to the town of "Hazar Asp: but it is only on reaching this latter place that the highly-

"cultivated lands of the Khivan oasis are fairly seen. From this place "to Khiva * * * the whole country is covered with smiling fields, "unwalled villages, and, as in Europe, houses and gardens in the open "fields, a proof of the feeling of security from oppression rarely met "with in civilised Persia. The alluvial tract is of little breadth, but is "intersected in all directions by canals for irrigation. Every spot "which has been reclaimed or preserved from the encroachment of the "surrounding desert, is carefully brought into cultivation. The im-"portance attached to husbandry in this country is marked by the "national ceremonies in opening the great canals for irrigation, which "are annually performed in the spring by the ruler of Khiva in person." He adds, "The ground being everywhere level, single-horse carts of "rude construction, the wheels without any girding of iron, are em-"ployed by the peasantry for the transport of their farm produce, "instead of, as in Persia, being carried on the backs of donkeys, horses, "and mules. Against the rearing of the latter there is a religious "prejudice."

Mr. Thomson's account of the country between Marv and the Oxus is hardly that of an unmitigated desert. There is a coating of verdure thrown over it in the spring which gives the appearance of a rich sward, extending in all quarters to the verge of the horizon. Nor is it unclothed with jungle. One tree grows to the height of 15 or 20 feet, and the very dryness of the wood renders it all that can be desired for the traveller's fire. But the scarcity of water, the absence of villages, and the severity of certain seasons, must be considered and provided for by those who, however prepared to rough it, in common parlance, would not wish to be classed with the fatalist pilgrim and the homeless wayfarer.

I will not weary your patience by describing Khiva or the sandy tract. For this has been done systematically and well by more than one recent writer, English and foreign. To revert to a prior remark, such persons as have never read, or, having read, have lost recollection of Abbott's and Shakespeare's journeys, should, if really interested in the subject, at once refer to these safe and genuine authorities, for they give no diluted information, nor tell second-hand tales, but speak from personal experience and ocular demonstration.

Jamshidis and Turkmans.—So much has lately been published about the Turkmans, that a very brief notice will suffice for such of the number as are found between Herat and Khiva. But before touching upon these marauders of the plains, something should be said on the people inhabiting the more mountainous country and valleys immediately contiguous, met with by both Abbott and Shakespeare on first leaving Herat. These are, for the most part, Jamshidis; and here we have a division of the Hazára tribe of Eimaks, speakers, according to Lord Strangford, of archaïc Persian. They dwell in black felt tents on the banks of mountain streams; they are shepherds, herdsmen, cultivators, and robbers; neither their courage nor general character is of a high order, and they assist, rather than oppose, the traffic in human beings, of the Turkman;

they levy iniquitous taxes on caravans, and, moreover, threaten and harass the Herátis, being only nominally, or occasionally, subservient to whatever chief or Government it appears policy to conciliate; they are scattered here and there about the Paropamisus in a destitute condition; and they now number, according to the best authenticated estimates, from 8,000 to 9,000 families (though Colonel Taylor says 12,000, capable of turning out 4,000 horse). The name, "Jamshid," is that of a Persian monarch of the fabulous period, and its use for purposes of clan distinction strengthens the belief that the families so-called came for the most part from Sistan, the cradle of Persian prehistoric heroes. Abbott represents them of Turkish origin, "short, "stout, very dark, with decidedly Tartar features." He may probably refer to the Moghul section of the Eimaks, who are not to be confounded with the Iranians; or it may be to home-returned descendants of compulsory colonists of the Lower Oxus, who had intermarried with local tribes.[1]

Shakespeare visited a large "khail" of Jamshidis. The "Khargahs," or nomad tents, of which there were about twenty, were arranged in lines, and there were calves and lambs inside the square. Abbott, as already stated, was at Khushk, the Jamshidi capital, a place dignified by a few mud huts and a *quasi* fort, in addition to the tents. He does not bear testimony to the precarious existence so many are reported to lead. For, in the present case, we are told, "the females seemed very "busy at their domestic arrangements, and the children fat and happy."

South of Panjdeh, and before the junction of the Khushk and Murghab, is the beat of the "Salor," a Turkman tribe, which Vambéry calls the oldest recorded in history. He gives them 8,000 tents, and a reputation for bravery. At the actual point of junction of the rivulet with the river, is the beat of the "Sarúk." To these, also, Vambéry attributes a character for valour, and rates the number of their tents at 10,000. The "Tekeh," the greatest and most powerful of the Turkman tribes, reckoned by the same authority at 60,000 tents, have one of their two principal encampments at Marv. Of the doings of these and the Yamuts, much is now communicated by correspondents of the press; and we shall probably hear much more, for there is a great change brooding over the occupants of the Tartarian Steppes. The range of the Tekeh is of considerable extent along the foot of the hills north of Persia and east of the Caspian, and the Yamuts are not only located at the south-east corner of the latter sea, beside the less numerous Goklans, but they have a special Khivan division in the neighbourhood of the Oxus.

Concluding Remarks.

I regret not to have had time to put before you a more complete map to illustrate this paper; the cross roads have not been checked as I could have wished; and the distances, except on the road described, have been taken from two of the twelve sheets of Central Asia, published by the Military Geographical Institute in Vienna.

[1] On this question, see "Selected Writings of Viscount Strangford," vol. ii, p. 160. (Bentley, 1869.)

This latest accession to general Oriental cartography, notwithstanding scarcely unavoidable inaccuracies and occasional vagueness of detail, merits attention as embodying much new matter. But, in asking you to accept for our present purpose a crude production, I may add that it will be my endeavour to prepare for the printed paper a map containing routes and places which have heretofore never appeared in a collective form. Major-General James Abbott, the same Officer whose journey to Khiva is now a standard reference, has kindly retraced in memory his work of 35 years ago; and only yesterday I had the great pleasure of receiving from him a paper of almost historical value, which may be turned to account in entering new, or checking heretofore recorded stations. It is an extract from his original Field Book of a rude survey made from the saddle in 1839–40; and supplies an interesting detail of his twenty-seven marches from Herat, accomplished from the 24th December to the 19th January inclusive.

There is, no doubt, much of truth in the charge laid against England of indifference in availing herself of opportunities to advance Science, readily presented in her political field; and, as a case in point, we have been told that the presence of our Officers in Persia through very recent years, was not utilised for acquiring that knowledge of the geography of the country, notably on the Northern and North-Eastern Frontier, which we, of all nations, should seek to possess. But in blaming ourselves, as we not unfrequently do, for political failures and shortcomings, might we not, at the same time, take credit for having acquired by the above-named or similar agencies, a good deal of information about Eastern and South-Eastern Persia, and Persian Baluchistan within the last ten or twenty years? The labours of the Engineer Officers and others, attached, or otherwise associated with my late Missions, have yet to be made public, and I trust that in two or three months more, their relation in print will afford proof that the pursuit of political objects and achievements of political results have not occupied the undivided attention of British *employés* in Makran and Sistan. And even where opportunity has not been afforded for out-door survey and research, it is believed that a residence of so many Englishmen, and for so long a time, in Persia has not been barren in fruits of observation. That the subject is not a popular one is no fault of theirs; nor is the fact that knowledge stored, is not knowledge used, to be visited on their heads. I can only say that so far as I can bear testimony, from some five years' experience in the superintendence of the Persian Telegraph and $2\frac{1}{2}$ years in Perso-Baluch and Perso-Afghan Boundary Missions, I should have no fear for the Officers employed in either department, were they called upon to pass a competitive examination in knowledge of the country and people, with the Officers of any other service whatever. In the meanwhile, I would take the opportunity of noting that important contributions to Persian Geography will be found in Major St. John's map in course of publication, and in the map[1] illustrative of Colonel Baker's and Lieutenant Gill's explorations about to appear, I believe, in the Journal of this Institution.

[1] Since published. *Vide* No. 79 of the Journal, Plate XVIII.—ED.

I will say a word in conclusion which relates to what is popularly called the Central Asian Question. Of the cross-roads imperfectly shown in the map before you, I think one of the most important is that which has Sarakhs for its centre. This place, if as well supplied with water as its nearness to the Tejend leads us to suppose, is of great value to Persia, and no pains or expense should be spared to make it a strong outpost. Of course there should be a capable Governor at Mash-had, and one capable of dealing with the Turkmans without room for interference by other and more powerful Governments. But Sarakhs is not the last or most remote of the Persian outposts on the North East. Marv is hers also by natural position, as should be the whole region of the lower Murghab; unless, indeed, Afghanistan had been powerful enough to have ruled the extreme valley of a river which arises among her native mountains. Whatever the geographical or scientific views on the territorial dispositions of rivers, it should be a universal, as it is a natural theory, that the country in which a river rises, and through which it runs its main course, should not be cut off possession at its mouth. The Danube does not offer a parallel case, for it passes through many nationalities; but let us take the Volga, the Seine, the Dnieper, the Thames—the intrusions of a foreign power at the *embouchure* of any of these, is too impossible a contingency to contemplate for an instant. The desert of Asia is not unlike the sea of Europe; its extent and character constitute it an admirable boundary between States; and the annexation by Persia of the basin of the Helmand, when the whole rise and progress of that river has been in Afghanistan, is one of those results which political revolutions have brought about in seeming opposition to the provisions of nature. In like manner any attempt to annex Marv from the Caspian, Aral, or Oxus, could only be instigated by the ambition of barbarism or the recklessness of a wholly selfish policy. Marv, if not independent, or too far from the sources and intermontane career of the Murghab to connect it with Afghanistan, is clearly Persian and part of Khurasan.

As Herat is the supposed key to India, so Marv is the supposed key to Herat. In considering the approach to this quarter from the north, we must not forget the present political as the permanent geographical situation of Bukhára, a place from which there is also a road to Herat of less than 600 miles. Vambéry is an admirable referee on this subject, and should be carefully studied by those interested. Both these roads cross the Paropamisus, a barrier which should be an efficient, as it is a natural one. That which I have had the honour of detailing to you may not be impracticable to artillery or any other arm with energy, ability, and will to aid and direct; but foreign invasion in these countries is beset with difficulties, and it is a question whether, upon the whole, they are not rather increased than removed by civilisation. Nadir Shah did not march to India with modern appliances, but neither had he, on the other hand, the physical incumbrances or moral scruples that would fall to the lot of existing commanders.[1]

[1] If I have avoided expressing any more decided political opinions on what may not inaptly be termed *the* "question of the day," it is because such expression might be here considered irrelevant or out of place. At the same time, I would take the

Lord LAWRENCE said: I think I may take it that it is the feeling of the assembly that we have had from the lecturer a most interesting and valuable paper on the routes from Herat through the desert to the oasis of Khiva. My friend Sir Frederic Goldsmid is well known for the zeal and the skill with which he has transacted matters of the greatest importance in Persia and Seistan. He has now, with much research and care, brought together a great deal of information which has been collected by Officers in the East Indian service. Much of this might have been lost; much when read, would have been interesting in itself; but when a man like Sir Frederic Goldsmid brings to bear the knowledge and information which he possesses so eminently, to illustrate such a subject, he is able to bring together much we should all wish to know, and to present it to us in a style eminently calculated to afford us interest and information in its most acceptable form. Independent of the information which we have obtained this afternoon, and which will I hope be printed for our benefit, we have also had the pleasure, though mingled with mournful feelings no doubt, of hearing the names again sounded of men celebrated in our armies for their enterprise and special abilities. A few of these men have survived to this day, and among them one I am happy to say who is still left to serve his country is Major-General James Abbott. In those days also I may mention the name of Moorcroft, and I must allude to the gallant and excellent soldiers and noble men, Stoddart and Conolly, who met with such a sad and wretched fate in the dungeons of Bokhara. No man will read the history of these times without dropping a tear over their sad fate or without honouring them as true patriots and as heroes. They felt that they were doing a great duty and serving their country, and they laid down their lives as martyrs for the cause which they had undertaken. The subject of Herat and the countries adjacent, is one of considerable importance to India, as is well known to most people in England, and especially to those whom I have now the pleasure of addressing. With regard to the best political arrangements to be effected under the special circumstances of this part of the world, it is not for me now to speak, but on your behalf I tender to Sir Frederic Goldsmid your hearty and grateful thanks for his admirable lecture.

opportunity of recording, as a result of personal experience in many countries of the East, an earnest hope that the attention of our rulers and politicians may not be drawn off from a subject, the thorough comprehension of which is so manifestly important as scarcely to brook an hour's delay.—F. J. G.

LECTURE.

Friday, January 15, 1875.

MAJOR-GENERAL F. C. A. STEPHENSON, C.B., Vice-Chairman of the Council, in the Chair.

PROPOSED ALTERATIONS IN THE ANNUAL MUSKETRY PRACTICE, SO AS TO BRING IT INTO ACCORDANCE WITH THE INFANTRY TACTICS OF THE DAY.

By Captain CHAS. K. BROOKE, 1st Battalion 15th Regiment, Brigade-Major, Hong Kong.

Read by Colonel the Hon. FREDERIC THESIGER, C.B., A.D.C. to the Queen.

THE question of the proper tactical formation for troops in the field has so engrossed the attention of all military writers, that an important branch of the soldier's training has not received the attention it deserves, or requires; I allude to our annual musketry practice. This all-important portion of our soldiers' training should, like our tactical formations, be brought into harmony with the altered conditions of warfare. In order to discuss this question, it is necessary first to define exactly, what ought to be the object of all musketry exercises. This I hold to be the training of soldiers, to inflict the maximum of loss on the enemy in the minimum of time. This condition can only be fulfilled when troops have been trained to fire with extreme accuracy, and also when this accuracy has been practised under conditions as nearly as possible representing the actual battle-field. Thus all musketry training must be directed to obtain accuracy of fire by means of target-practice; and good individual firing by practices representing as closely as possible the normal features of a battle-field. A few alterations in our musketry regulations, if carried out, would bring them into harmony with the above principles.

The Position drill as laid down, does not recognize the lying-down position, or what is most generally called the "*Any* Position"; and since the number of rounds which will be fired in this position on the field of battle must largely exceed those fired standing, it is desirable that men be trained, on broken as well as on level ground, to choose those positions which are most comfortable to them, the Instructor noticing that nothing in their position would tend to produce inaccuracy in firing. I would therefore suggest that a fourth practice in the

"any position" should be added to the existing drills. This practice could be easily carried out in the barrack-square on rough straw mats, made by the troops themselves.

The first part of our annual musketry practice consists in firing singly 60 rounds at different sized targets at different distances. In this practice only 20 rounds need be fired at ranges below 400 yards. The question arises, does this represent truly the probable proportion of shots in 60 that will be fired at this distance on the field of battle? I think no one will venture to say that it does; overwhelming testimony mght easily be produced in order to prove that it is exactly between 150—400 yards that the most effective fire is delivered in action. It will be enough to quote one or two writers of eminence on the subject. Leyman in his "Frontal Attack" states, "that by com-" mencing to fire at long distances, the men get excited and out of hand, " and ammunition is expended with little visible result; whereas troops " who do not open fire until within effective range, will obtain certain, " and in many cases indeed visible results from their shooting, and thus " are enabled to establish their confidence and calmness." Boguslawski in his "Tactical Deductions" states, "that the Army which takes to " shooting at long ranges will have cause to rue the practice when " opposed to a cool adversary." Lastly, von Scherf, the ablest exponent of the "New Tactics of Infantry" (writing when the Mauser rifle had been adopted), states "that fire, if possible, should not take place " till within 480 yards of the enemy, and that then only individual " firing by word of command should be allowed, when you can no " longer dispense with its animating effect, or when special reasons for " it arise" (such as the necessity of driving in advanced parties of the enemy, &c.); and "that only when the skirmishers have advanced " to within the most effective range of the enemy, say from 320—160 " yards, will an unmistakeable command or signal be given, upon " which a rapid independent fire as much concentrated as possible upon " a point previously indicated will be opened, and will be maintained " until the moment of the actual assault."

From these opinions, expressed by able men, who have formed them from actual battle experience, I think it can be safely assumed that it is *within* 400 yards that the most effective infantry fire takes place; therefore it is necessary that the greatest stress should be laid upon our practice within this distance; in consequence, instead of only *twenty* rounds being expended annually in target practices at these vitally important ranges, I would suggest that *forty* rounds should be expended on them, and that the remaining twenty should also be expended on them, unless a man is able to show by a high number of points that he is a certain shot within 400 yards.

To carry this out it would be necessary that our present practice be remodelled, and I would suggest the following arrangement, not as absolutely the one possible solution, but as showing the direction in which the necessary alterations must take place.

First: as regards the targets, I would propose the employment of four, the additional one to be called the "Marksman's Target,"—a detailed description of which will follow.

Since the object of all shooting is to disable as many as possible of the enemy, it follows that soldiers should be so trained in peace-time as to be able to fire with accuracy at individual men on the field of battle. In order to obtain this result, I propose that the centre of the target fired at in the 3rd class should be 16 inches broad and 3 feet high; this space representing a man's trunk and thighs when standing, or the whole man if kneeling. The bulls-eye to be 8 inches broad and 18 inches high, representing the vital portion of the trunk.

The ranges and conditions for firing in the 3rd class to be as follows:—

Range in yds.	Conditions.
100	Standing.
150	Standing.
200	Kneeling.
250	Any position.

3rd class Target. (Appendix I.)

Outside measurement		6′ × 4′
Area of outer	=	20 sq. ft.
„ centre	=	3 „
„ bulls-eye	=	1 „

The lines enclosing the centre to be $1\frac{1}{2}$ inches broad, in order to be clearly seen up to 250 yards, the area of the centre being enclosed by the inner edges of these lines.

In order approximately to determine the necessary data for getting out of the 3rd class I made calculations, shown in Appendix II, based on the firing of four companies of my regiment, which ranked as 3rd, 5th, 9th, and 10th when finally classified, and of which the average final classification was 68·04.

In these calculations I first determined the number of shots striking the actual bulls-eye's, centres, and outers at the different ranges. Secondly, I compared their areas with that of those proposed, and hence deduced the number that ought to strike the different portions of my proposed targets. Lastly, by making allowance for the different conditions of firing, I calculated that in round numbers a man ought to make in his twenty rounds 10 outers, 4 centres, 2 bulls-eyes, *i.e.*, 16 hits; and from the addition of the calculated value of the shots at the different ranges that he should make 43 points.

From these data I would fix at 43, the number of points a man should make in order to pass into the 2nd class; but the obtaining of these points I would couple with the conditions of making 6 centres or bulls-eyes, and of hitting the target sixteen times. The number of points suggested would most probably have to be altered, when experience has been obtained from extended practices at the proposed target; but the principle of coupling the making a certain number of points with the making a definite number of bulls-eyes or centres, and also with the making a definite number of hits, is the vital part of my propositions; for by insisting on these conditions, a definite idea of the

value of each man's individual firing can be obtained; this value being represented by the fact that all men in the 2nd class have shown themselves capable of hitting a target 6′ by 4′ sixteen times in twenty rounds, and further, that six of their shots have struck the centre, representing the body of the man aimed at, *i.e.*, that a little less than one-third of the shots fired by them will put a man *hors de combat*.

This is a definite and palpable gauge of a man's firing, whereas under the present system no such clue is obtainable; 3rd class shots being able to pass into the 2nd class by only striking the target nine times in their twenty rounds; while 2nd class shots can pass into the 1st class by only striking the target eight times.

All Instructors of Musketry with whom I have talked on the subject state that they think more of the man who is always on the target than of the man who perhaps makes a little larger score, but who scores bulls-eyes and centres interspersed with several misses.

The following objection will of course be made, viz., that supposing a man has missed the target four times before he has fired his twenty rounds, he will be disgusted, and will no longer try to hit the target with the remainder of them. I admit that this is likely, and I would get rid of the difficulty by stopping a man's shooting, the moment it becomes impossible for him to get out, and by making him commence *de novo*, until, in twenty consecutive shots, he has fulfilled the conditions for passing into the higher class. By adopting the principle of twenty consecutive rounds being sufficient to pass a man from one class to another, encouragement would be given to him to persevere, because no rounds would be wasted, for from the moment the conditions became impossible of attainment, at that moment he would leave off and commence anew.

This principle being conceded, it remains to be considered how its practical working can be carried out. Of necessity it must lead to a slight modification of our present method of conducting target practices, the following rules being absolute:—1st, that no more than twenty rounds be fired by one man in one day; 2nd, that no man fire less than five rounds at any range, except when it is impossible that he can fulfil the conditions of the class he is firing in. Two examples will best demonstrate the course to be pursued.

a. Private X, after firing seventeen rounds in the 3rd class, has missed the target four times, or has not hit the centre more than once, or has only made thirty points; in any of these cases, he cannot, with his remaining three rounds, pass out of the class he is firing in, consequently he is ordered to cease firing, and has three rounds in his pouch; these are instantly received by the sergeant in charge of the squad. As Private X has only three rounds, he cannot fire any more on this day.

b. Private Z, after firing thirteen rounds, has missed the target four times, consequently he cannot get out; he likewise at once hands his seven surplus rounds to the sergeant; but if the Officer in command deems it advisable, he can fire five rounds on this day at the first distance in the 3rd class.

The proposed alterations will therefore only entail a little more

labour and care on the Officer keeping the register; and if amended forms were issued in accordance with the above proposals, this extra trouble would be reduced to a minimum.

In order to see if the conditions for getting out of the 3rd class were approximately correct, I fired at Alderney a squad of five, consisting of four Officers and a colour-serjeant, at the ranges, and under the conditions above mentioned, and at my proposed 3rd class target, with the following results:—Average number of points obtained, 53·4; average number of bulls-eyes, 3; centres, 8; and only two misses were made. The shooting was 25 per cent. better than the calculated value; but this was due to the fact that of those who were firing, two were fair, and three good regimental shots. The general opinion arrived at (two musketry instructors being among the four Officers firing) was, that the conditions were fair for the men, and that, as a practical class for training men for their duties in the field, it was greatly superior to our present 3rd class. In Appendix III is given the register of the target practice.

2nd Class.

Since the object of the 2nd class should be to train men to fire with accuracy at a small object, and thus enable them to hit with certainty a single man in the field, and that its conditions should be such as to prevent all but certain shots at the short ranges passing into the 1st class, it is necessary to devise some method by which the size of the object aimed at shall be diminished, and yet which shall not be so small as to cause the probability of many misses; it being assumed that not hitting the target at all, is apt to discourage the men firing, and yet in the 2nd class no shot that does not hit a small object should score.

In order to satisfy these conditions, I would propose the employment of the 2nd class target (shown in Appendix IV); it is of the same size as the proposed 3rd class target, and has a similar centre and bulls-eye, enclosed in a central band 2 feet broad, by two vertical black lines; these lines, and the upper and lower ones enclosing the centre, are 2 inches broad, in order to be distinctly visible up to 350 yards.

The ranges and conditions for firing in this class to be as follows:—

2nd Class Target.	Range in yards.	Conditions.
Outside measurement, 6′ × 4′ ..	200	Standing.
Area of outer = 8 sq. ft.	250	Kneeling.
,, centre = 3 ,,	300	Any position.
,, bulls-eye = 1 ,,	350	Any position.
,, dead portion = 12 ,,		

No shots striking on or outside vertical black bands to score.

By making use of the above target, and by obliging it to be struck a certain number of times, but allowing only those shots which strike in the central 2 feet band to score, the hitting a small object is assured, at the same time few shots are allowed to miss the target. From calculations (shown in Appendix V) similar in character to those described as being employed in order to determine the data on which

to fix the conditions necessary to pass from the 3rd into the 2nd class, I find that in order to become a first-class shot, a man in the 2nd class ought to make 28 points, coupled with the conditions of making 5 centres or bulls-eyes, and hitting the target 16 times. These calculations are based, not on the average shooting of the men at the different ranges, but on shooting 10 per cent. better.

I would propose that the shots striking outside the central band, should be signalled by means of the centre and outer flags held out together, and that on the register they should be shown by the letter H.

In Appendix VI is given the register of the target practice of the same squad who fired at the proposed 3rd class target; the average number of points obtained was 36·4, average number centres and bulls-eyes, 6·6. One Officer failed to get out from want of points, another from not having made the necessary number of bulls-eyes and centres. The opinion of those firing was, that the conditions were fair for a good shot, and that the vertical black lines materially aided the aiming, and that the target was clear and distinct at all ranges.

1st *Class.*

Since the chance of hitting a single man at ranges over 400 yards is slight, the object of the 1st class should be to train soldiers to hit the small group of men which will inevitably be formed by the enemy during his advance upon a position, the slightest chance of cover having a powerfully attractive force; in consequence, it follows that vertical accuracy is more needed than lateral, that is to say, it is more important to hit a horizontal band than a vertical one, because if men find cover during their advance, they will close up to it, and thus rather offer a broad, than a deep or high object. Again, when acting on the offensive, the object aimed at will be a dense line of men, probably partially sheltered; consequently in this case also vertical accuracy is more needed than lateral. Therefore, in this class men must be trained to attain this vertical accuracy, and this object will, I think, be best secured by a target of the following description, shown in Appendix VII. As it is important at the longer ranges that few shots should go off the target,—first, because their going off discourages the man firing; second, because if he cannot learn the exact spot where his bullet struck, he cannot satisfactorily alter his aim,—I propose that the target to be fired at in the 1st class should be 6′ high and 8′ broad; the centre 3′ high and 8′ broad representing a group of four men kneeling. The bulls-eye to be a horizontal band 18 inches high and 6′ broad; the central 2 feet portion to be black, and its extremities to be defined by black vertical bands 6 inches broad, the total area being marked by a thin black line connecting those portions which are black, the whole representing the head and shoulders of three men kneeling behind slight cover; the vertical bands at the extremity of the bulls-eye will afford marks by which the distance to be aimed off the central bulls-eye, can be estimated. The outer to consist of the upper and lower 18 inches of the target. The lines enclosing the centre

to be 6 inches broad, in order that the centre may be well defined up to 600 yards.

The ranges and conditions for firing in the 1st class to be as follows:—

1st Class Target.	Range in yards.	Conditions.
Outside measurement, 8′ × 6′ ..	400	Kneeling.
Area of outer = 24 sq. ft. ..	500	Any position.
,, centre = 15 ,, ..	550	
,, bulls-eye = 9 ,, ..	600	

In order to obtain a more definite representation of the value of the shots striking the target, I would propose that at the 500, 550, and 600 yard ranges, those shots which strike the central black portion of the bulls-eye should score 5; those on the white portions and vertical black bands, 4; those within the horizontal black bands, 3; and those on these bands and on the white portion of the target above and below them, 2. At 400 yards I would suggest that no shots striking this latter part of the target should score, but that they should only be counted as hits; this proposition is devised in order to get rid of the chance that a man at this range might be tempted to fire carelessly, owing to the large size of the target. I would also reduce the value of those striking on the remaining portions by 1; thus at this range a central bulls-eye would score 4; a right or left one, 3; and a centre, 2.

The central bulls-eye at the 500, 550, and 600 yards ranges would be signalled by the centre and outer flags raised together, and the hits on the dead portion of the target at the 400 yards range would be similarly signalled.

Since the area of my proposed 1st class target is greater than that of the existing target fired at the same ranges, and since the men firing at the former would be the picked shots of the company, while the latter is fired at by all the men of the company; any calculation of value based on the firing of men at the 2nd class target in 1873 is impossible; therefore I have made none, more especially as only accurate data would be valuable in a calculation which would fix the number of points requisite to obtain the marksman's prize.

In Appendix VIII is given the registers of the target practice made by two squads, one of five Officers and a colour-serjeant, the other of seven Officers and a colour-serjeant, the average number of points made being 45·07, average number of bulls-eyes and centres 9, hits 16·88. The general opinion was that the fair number of points would be 40, coupled with the conditions of making 7 bulls-eyes or centres and hitting the target 16 times. The target was clear at all ranges, and great definition was given by the horizontal black bands, which made it a much better target to aim at than the existing second-class one. The alteration in value of the shots was unanimously approved of, as tending to give a better representative idea of a man's shooting.

Marksman's Class.

Those men who fulfil the above conditions I would classify as marks-

men, and as they will have proved themselves to be good and certain shots at ranges up to 600 yards, it may be assumed that they will probably prove good shots at the longer ranges of 650, 700, 800, 950 yards, and therefore I propose that an extra twenty rounds should be granted to them, in order that they may compete amongst themselves for the prize for being either the best shot of the company, or of the battalion.

These extra rounds, allowing that 10 per cent. of the men firing qualify, would only entail an additional expense of £4 3*s*. 4*d*. in a battalion of 500 men—a slight expenditure considering the moral and material advantages to be derived from it; moral, by leading to increased emulation in order to obtain the honour of firing in the marksman's class; material, by affording an extra practice to those who will presumably greatly benefit by it. It may be objected that these extra rounds, being only granted to marksmen, will prevent the mass practising at the longer ranges; I allow that this will be the case, and I hope that the mass will never in action be allowed to fire at any range over 600 yards, because it would inevitably lead to an immense waste of ammunition, and be liable by the confusion and smoke it would cause, to prevent really good shots from doing their best. I would rather that only marksmen fired at these long ranges, for their great use would be when on the defensive, and being placed at the salients of the position, or pushed forward in advance of the position in order to make the enemy develop his dispositions for attack (V. Scherff, page 127, 9th line, and page 129, 9th line), to prevent the near approach of artillery, and to break up the small columns, in which formation the enemy's infantry at this distance would most probably advance. On the offensive, not only would these picked shots be able, to inflict loss on the enemy, and drive in his advanced infantry and artillery, but their cool and deliberate manner of firing would steady the nerves of the remainder of the men of the regiment, who would thus be more easily kept in hand till their services were required at the nearer ranges.

Allowing that it is advisable that only picked shots of a regiment should be practised at ranges exceeding 600 yards, the nature of the target at which these marksmen should fire, remains to be determined.

As regards its size. From the result of the firing of 770 rounds, at ranges of 650, 700, 750, and 800 yards, at a 1st class target, placed in front of an experimental target 18 feet broad and 13½ feet high, I found that of the total number of the shots fired, 270 struck the 1st class target, and 164 struck the experimental target within a 2 feet band enclosing the 1st class target. These shots were distributed as follows: 62 on the band, 1 foot by 8 feet, just above the target, 43 on a similar band above the former, 33 on a band 2 feet by 6 feet on the right side of the target, and 27 on a similar band on the left side. From the above it will be seen that no less than 16 per cent. of the total number of shots which struck the 1st class target and the 2 feet by 8 feet band above it struck the latter; and if it be remembered that from 600—700 yards the bullet has a fall of about 1 in 5, from 700—

800 yards about 1 in 4, and from 800—900 yards 1 in 3, it must be allowed, considering that at these long ranges groups of men having a certain depth, or small columns, will have to be broken up, that these shots which only miss our 1st class target by 2 feet would have a definite value on the field of battle; therefore I would suggest that the target to be fired at by the marksmen should be 8 feet high. This increase of height, besides enabling shots which would be effective on the field of battle to score, would also aid the men firing to obtain quickly the true sighting of their rifles; and lastly, it would compensate for the disadvantages of many ranges, in which it is impossible to see the bottom of the target, owing to very trifling inequalities on the range.

As regards the width of the target, I would suggest that it should be 12 feet wide, in order to enable the men firing to better estimate the exact amount of allowance to be made for their pull off, or for the wind. How often one has seen known good shots unable to get on the target when firing in the first class, from not having any definite idea as to where their shots are going; by increasing the total area of the target this difficulty is obviated, and consequently the training of those firing is aided.

The practical method by which this increase of height can be given to the target is as follows:—Lay three targets with their faces down on the ground, and place a fourth target along their three ends, and secure it to them by means of six screws with nuts passing through the side flange of the target placed lengthways, and through the end flanges of those which will be in a vertical position when raised. The weight of these four targets thus combined to form one-half of the proposed marksman's target will weigh one ton, but as one-half will rest on the ground, the greatest amount of lifting force which will be required at the first moment of raising them will be half a ton, and as four men can take hold of the upper edge, and two men on each upper side edge, eight men can lift together, giving only at the first moment 1¼ cwt. for each man to raise, not a difficult feat for any soldier to execute. Thus, as each range possesses eight targets, each 6 feet by 2 feet, no extra targets will be required in order to make use of the proposed marksman's target, and the only expense attending this alteration would be caused by drilling 24 holes in the flanges of the targets and providing twelve screw bolts, not a large sum to demand when the advantages to be derived from its increased size are considered.

In Appendix IX is shown the marksman's target, the bulls-eye being made slightly larger than that of our present 1st class target, in order to make it a good object to aim at up to 950 yards. An extra enclosing line besides that of the centre has been added, for the purpose of obtaining a better representation of the value of each shot. In scoring, the central bulls-eye would score 5, the outer bulls-eye 4, centre 3, and outer 2, at the 800 and 950 yards ranges; and at 650 and 700 yards ranges no shot striking the outer portion of target would score. I have proposed the above ranges because at the present time it is important that the picked shots of a battalion should be practised up to at least 950 yards, and up to the limit of the range of their

weapon, if ammunition could be granted for the purpose; for the value of picked shots will be best demonstrated when they can can prevent by their accurate fire the near advance of artillery, and oblige the enemy to break up his closed fraction at long distances.

Having now suggested how 60 rounds should be expended in target practices, it remains to be considered how the other 30 rounds are to be utilized, so as to best train our soldiers for their duties in the field.

According to existing regulations, 10 rounds are expended in volleys at 300 yards, both ranks kneeling, 10 rounds in independent firing at 300 yards, and 10 rounds in skirmishing, advancing from 400 yards to 200 yards, and retiring from 200 to 400 yards. The first question that must be asked is, does this represent truly the proportion of volleys, independent firing, and skirmishing that has recently, or will in the future take place on the battle field? As regards volleys, all writers who speak from experience gained in the last battle fields state that "the cases in which volleys were fired in a downright "infantry engagement would probably be easily reckoned; the few "cases in which volleys can be well authenticated were when the "French were surprised."[1] "Neither French nor Germans ever succeeded in pushing forward battalions or companies to fire volleys."[2] "Even when on the defensive, to which according to theory, volley "firing is particularly applicable, it could so seldom be employed, that "the few exceptions prove the rule. Even behind cover, field works, "barricades, &c., the fire of *dense clouds of skirmishers* was preferred to "bringing forward parties in close order to fire volleys."

From the above facts, I think it may be concluded that an expenditure of three rounds in volleys at 300 yards and of two at 200 yards is all that is necessary for the sufficient training of troops in volley firing.[3] It is difficult to estimate the value of independent firing as now practised, but I think it may be assumed that since there is little probability of troops being brought to the front in a closed formation in order to fire volleys, that there is hardly any possibility that they will be called upon to practise independent firing. The nearest approach to this species of firing will be that of the "dense clouds of skirmishers" mentioned previously, and for this kind of firing our present practice affords no adequate training. I would therefore suggest that the independent firing practice be done away with, and that the remaining 25 rounds be all expended in a skirmishing practice, which should represent most closely the special conditions under which men will fire on the battle field.

Such a practice must be acknowledged to be the most important and the most essential portion of our soldiers' annual musketry training, as the preliminary target practices can only be considered to be useful, in

[1] "Tactical Deductions," by A. Boguslawski, p. 79. [2] *Ibid.*, p. 84.

[3] The target shewn in Appendix X, to be 12′ broad, 6′ high, having a black band 18″ broad running across its centre, and line 1¼″ to enclose a central 3′ band; the scoring to be 4 points for shots striking the black band, 3 for the central band, and 2 for the upper and lower portions of the target; due value being thus given to vertical accuracy.

so far as they enable us to classify the men, and to train them to make good individual firing in the skirmishing practice. At the present time all importance is given to the target practices, and the skirmishing is made completely secondary to them; therefore until this order of precedence is reversed and the importance of training men to skirmish inculcated, and not till then, will the skirmishing practice assume the importance due to it, and create the interest in it so necessary for its successful carrying out.

It remains now to be seen how the greatest possible instruction may be obtained from the expenditure of these twenty-five rounds: as this is *par excellence* the battle-field practice, the conditions under which it must be carried out must of necessity represent it as closely as possible; firstly, as regards the object aimed at; secondly, as regards the nature of the ground on which it takes place. We may do much to improve our practice in the former of these points; in the latter, want of necessary ground, and the densely-populated character of the country, forbid any but trifling ameliorations of the actual conditions.

In our skirmishing target practice the object aimed at is an immovable target 6′ × 2′ in the field, the object aimed at is a mobile man, whose size would vary from 5′ 6″ × 16″ through 3′ × 16″ to 1′ × 16″, according as he is standing upright, kneeling, or lying down. This enormous difference between the object practised at on the range and the object fired at in the field of battle is startling, when it is considered that no real reason for it exists. Our targets have remained unchanged, though the introduction of breech-loaders has altered the character of the objects aimed at on the battle-field. In this point, therefore, it will be necessary, in order to bring our practice into harmony with existing facts, to take to firing in our skirmishing practice at easily-moved man targets, a plan adopted by other nations with great success. As regards the nature of the targets, they must be most inexpensively constructed, otherwise a difficulty would arise to their being introduced into the service; for this reason I would suggest that they should be made of canvas, covered with paper cartoons, and stretched on a light iron frame; a light rod attached to their upper edge would form a back support in order to keep them in a vertical position. It would be necessary to have two sizes, one 5′ 6″ high and 1′ 4″ broad, having a paper representation of a man attached to it, the other being 3′ high and 1′ 4″ broad, and having affixed to it the representation of a man kneeling. The estimated cost of the blocks from which these cartoons would be printed is 30 guineas for the standing figure and about 25 guineas for the kneeling one. The cost of each cartoon need not exceed 2*d*. The cost of iron framework of a standing target would be about 11*s*. 6*d*., that for the kneeling figure 8*s*. 6*d*. I would suggest that each range should be furnished with six of each size, and that the paper cartoons should be drawn from store as required: by careful patching they could be made to last a long time. I would also suggest that the figure aimed should represent a man in blue uniform, because it is well that our soldiers should be accustomed to fire at this colour, it being the most general colour in all armies except our own. The standing figure should represent a man standing

with ordered arms; the kneeling figure, that of a man at the "present" when on the knee.

As it is probable that men will in the future be called upon to fire at others within fieldworks and behind shelter-trenches, I would suggest that a paper screen, coloured with burnt sienna and 4' 6" high, should be fastened with clips in front of the standing figure in order to represent a man firing behind a parapet, and that a similar screen, 1' 6" high, should be placed in front of the kneeling figure, thus representing a man firing from behind a shelter-trench, it being understood that all shots striking on these screens should not score, but only count as hits.

The skirmishing practice as above suggested represents four conditions likely to occur on the battle-field, and I think that with advantage a fifth might be added to it, viz., the representation of a moving man, by means of a vertical man target placed on a light truck and drawn by cords across the range. The skirmishing practice that I would suggest, and in which the above targets can be thoroughly utilized, is as follows:—

Five rounds in any position, at standing man target, at unknown distances between 400 and 200 yards, this being ensured by the moving both of targets and men, according to a settled plan arranged between the Officer commanding the company and the Musketry Instructor.

Five rounds in any position, at standing man target, having the ground screen on, at unknown distances between 400 and 200 yards.

Five rounds at a moving standing man target at 200 yards, two rounds standing, three rounds in any position.

Five rounds in any position at kneeling man target, at unknown distances between 400 and 200 yards.

Five rounds in any position at kneeling man target, having the ground screen on, at unknown distances between 400 and 200 yards. These ground screens, besides serving to represent men firing behind earthworks, would also train our soldiers to fire at men sheltered behind the natural inequalities of the ground. The above practice I would suggest should be carried out under the direct supervision of a Field Officer, so that the natural tendency of Officers commanding companies to facilitate the execution of this practice, in order to obtain a high score, may be obviated. In short, too much attention cannot be paid to this practice; for, as I have said, before it constitutes the real battle training, to which all target firing has only been accessory.

Before concluding, two points must be briefly adverted to. First, as regards the dress of the men while firing; secondly, with regard to how the "figure of merit" is to be calculated.

When our soldiers practice at the ranges, they fire without their knapsacks. Is this right? Will they on the field of battle be without them. I venture to say no. Therefore, why liberate a man's arms during his training, and curb his freedom when the moment for action arrives? He will be none the better for his training, and when to the excitement of battle is added the *gêne* of unaccustomed incumbrances, the men will fire considerably worse than they themselves

anticipated, and be tempted to get rid of their burdens in order to fire in the condition in which they have been trained. For these reasons I consider that men when firing on the range should be in "marching "order" (knapsacks inspected to see that they are full), and thus in peace time be accustomed to the restraint to which they would have to submit in action.

The object of the "figure of merit" is to classify the different regiments, and consequently a spirit of emulation is produced between them, the secondary effect of which is, that all those practices whose score does not tend to swell the "figure of merit" are often pushed on one side and somewhat neglected. This is natural, but it is preventible. Under the existing system, if a man fails to get into the 1st class after the completion of his first 40 rounds, he has to fire again in the 2nd class, if he has succeeded in getting out of the 3rd class, or in the 3rd class, if he has failed in getting out of it. The 20 rounds expended in the 2nd class are likely to be fired under every disadvantage, and simply got through; because the number of points obtained in this class with the last 20 rounds devoted to target practice, in no way affects the figure of merit of the regiment; whereas the 20 rounds in the 3rd class are never fired till favourable circumstances occur, because the leaving many men in the 3rd class considerably diminishes the figure of merit of the regiment; though even here when a man has got out, or when he no longer has a chance of getting out, his remaining rounds cease to interest, as they do not score.

In order to get rid of these difficulties, I would suggest the following method of calculating the "figure of merit":—

1st Period.

The average number of points obtained by every man in his attempt to pass into the 2nd class. This would be arrived at by dividing the total number of points obtained by the total number of rounds fired.

2nd Period.

a. The average number of points obtained by every man in his attempt to pass into the 1st class.
b. One-third the average number of points obtained by every man in his second attempt to pass into the 2nd class.

3rd Period.

a. The average number of points obtained by every man in his attempt to pass into the marksman's class.
b. One-half the average number of points obtained by every man in his second attempt to pass into the 1st class.
c. One-fourth the average number of points obtained by every man in his third attempt to pass into the 2nd class.

4th Period.

a. The average number of points obtained by the men firing in the marksman's class.

b. One-half the average number of points obtained by every man with his remaining rounds in the 1st class.

c. One-third the average number of points obtained by every man with his remaining rounds in the 2nd class.

d. One-fifth the average number of points obtained by every man with his remaining rounds in the 3rd class.

Volley Firing.

The average number of points made in volley firing.

This plan may appear complicated, but when it is examined it will be seen that every shot that a man fires has a direct influence on the "figure of merit," and therefore a sustained interest will be kept up, and the vigilance and activity of the Company Officers will never be tempted to flag for an instant. Every inducement is given in it to make a large score, and also to pass into the higher class, because a second attempt in a lower class cannot be so remunerative as a first attempt in a higher class; in the same manner a third attempt in a lower class is not so remunerative as a second attempt in a higher one. As regards our present registers, little alteration would be required. A dividing line down the space headed "Total Points" would enable "total rounds," as well as "total points," to be inserted, and hence the averages calculated.

In now bringing my paper to a close, I will briefly recapitulate the conclusions arrived at.

1st. That the "any position" must be recognised as the most probable one on future battle-fields, and that therefore our soldiers must be trained to practice it in peace-time.

2nd. That the proportion between the number of shots fired during our annual musketry practice, at short ranges, does not truly represent their probable expenditure on the field of battle.

3rd. That by adopting in principle the proposed re-arrangement of the different classes, and the alterations in the targets, and in the conditions under which they are fired at, our musketry training will be brought more into harmony with the modern conditions of warfare.

4th. That by obliging every man to make a certain number of bulls-eyes or centres, and hits, before passing into a higher class, a more definite idea of his value as a shot is obtained.

5th. That by arresting a man's shooting, at the moment when it ceases to be possible that he can fulfil the required conditions for passing into a higher class; and by an alteration in the method of computing the "figure of merit"; no shots are wasted, each one having a direct interest attached to it, and thus their value for training our soldiers ensured.

6th. That by establishing a marksman's class, picked shots receive the extra training due to their extra skill.

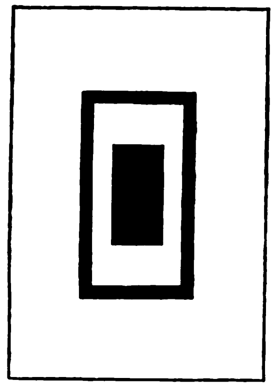
Lastly. That by the alteration in, and by the importance given to, the skirmishing practice, the battle training of our troops is largely increased, and our musketry training brought into harmony with our "attack formation."

In conclusion, I trust that the suggestions I have made will be

understood to be purely tentative; it must not be thought that I wish in any way to dogmatise on the subject. It has been my earnest endeavour to point out what I conceive to be the errors of our present musketry training, and at the same time to shadow forth the direction in which it may be altered, leaving to those having a wider experience on the subject, the duty of weighing what I have said, adopting that which may be of use, and rejecting that which may be found impracticable.

APPENDIX I. 3RD CLASS TARGET, 6 ft. × 4 ft.

Range.	*Conditions.*
100 } 150 }	Standing.
200	Kneeling.
250	Any position.



Centre (inside measurement), 3 feet × 16 inches.
Bulls-eye, 18 inches × 8 inches.
Lines enclosing the centre $1\frac{1}{2}$ inches broad.

APPENDIX II.

By taking the result of the firing of four companies, I find that—

At 150 yards,	159	bulls-eyes,	314	centres,	270	outers.
„ 200 „	146	„	274	„	232	„
„ 250 „	104	„	204	„	264	„

were obtained by 166 men firing standing.

By calculating the area of my proposed 3rd class target, and by comparing it with the actual one in use, I find that the area of

The proposed outer = actual outer + $\frac{2}{3}$ actual centre.
„ centre = $\frac{1}{3}$ „ centre + $\frac{1}{2}$ „ bulls-eye.
„ bulls-eye = $\frac{1}{2}$ „ „

By making use of the above proportions, the following data are obtained:—

At 150 yards, shots striking proposed	outer	= 270 + 210 =	480
„ „ „	centre	= 104 + 80 =	184
„ „ „	bulls-eye =		79
At 200 yards, „ „	outer	= 232 + 183 =	415
„ „ „	centre	= 91 + 73 =	164
„ „ „	bulls-eye =		73
At 250 yards. „ „	outer	= 264 + 136 =	400
„ „ „	centre	= 68 + 52 =	120
„ „ „	bulls-eye =		52

From the above, I calculate that each man at 150 yards, firing five rounds standing, should obtain—

2·89 outers	= 5·78	points.
1·10 centres	= 3·30	,,
·47 bulls-eye	= 1·88	,,

At 100 yards a man should shoot 5 per cent. better than at 150 yards, he should therefore obtain—

3·03 outers	= 6·06	points.
1·15 centres	= 3·45	,,
·49 bulls-eyes	= 1·96	,,

Again, at 200 yards, firing five rounds standing, a man should obtain—

2·50 outers	= 5·00	points.
·99 centres	= 2·97	,,
·44 bulls-eyes	= 1·76	,,

and if he kneels, I think it may be assumed that his shooting should be at least 20 per cent. better, and he should therefore obtain—

3·00 outers	= 6·00	points.
1·18 centres	= 3·54	,,
·53 bulls-eyes	= 2·12	,,

Lastly, at 250 yards, firing five rounds standing, a man should obtain—

2·40 outers	= 4·80	points.
·72 centres	= 2·16	,,
·31 bulls-eyes	= 1·24	,,

but if a man lie down, his shooting should be at least 20 per cent. better, and he should therefore obtain—

2·88 outers	= 5·76	points.
·86 centres	= 2·58	,,
·37 bulls-eyes	= 1·48	,,

To sum up—

Range.	Conditions.	Outers.	Centres.	Bulls-eyes.
100 yards,	standing	6·06	3·45	1.96
150 ,,	,, ...	5·78	3·20	1·88
200 ,,	kneeling	6·00	3·54	2·12
250 ,,	any position .	5·76	2·58	1·48
		23·60	12·77	7·44

In round numbers, 10 outers, 4 centres, 2 bulls-eyes = 16 hits = 43·81 points.

APPENDIX III.

1st Battalion. 15th Regiment. Experimental Firing.

REGISTER OF TARGET PRACTICE.

1st Period. 3rd Class. No. of Targets fired at, 2.

Dated at Alderney, 1st April, 1874.

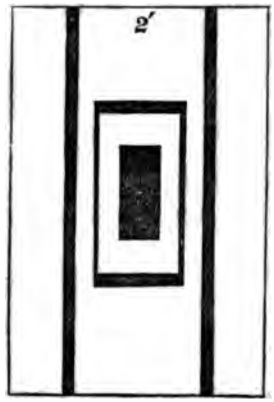
No. as per Practice Return.	Rank and Name.	1st Practice.						2nd Practice.						3rd Practice.						4th Practice.						Total points in period.
		100 yards.						150 yards.						200 yards.						250 yards.						
		Points per shot.					Total points.	Points per shot.					Total points	Points per shot.					Total points.	Points per shot.					Total points.	
		1	2	3	4	5		1	2	3	4	5		1	2	3	4	5		1	2	3	4	5		
1		4	2	4	2	2	14	2	2	3	2	2	11	2	4	2	0	2	10	3	3	3	2	3	14	49
2		3	3	3	4	3	16	3	2	4	3	4	16	2	3	3	2	3	13	2	3	0	3	2	10	55
3		3	3	4	3	3	16	3	4	2	4	2	15	2	2	2	3	3	12	4	2	2	3	2	13	56
4		2	2	3	3	3	13	4	2	2	2	2	12	2	3	2	2	2	11	2	2	3	3	4	14	50
5		3	3	3	3	3	15	3	3	4	3	4	16	2	2	3	3	2	12	2	3	4	3	2	14	57
		Total..........					74	Total..........					70	Total..........					58	Total..........					65	267

Direction of wind, ; very strong. **Average points ...... 53·4**

APPENDIX IV. 2ND CLASS TARGET, 6′ × 4′.

Range.	*Conditions.*
200	Standing.
250	Kneeling.
300	Any position.
350	Any position.

No shots striking on, or outside vertical black bands, to score.



Centre (outside measurement), 3 feet × 16 inches.

Bulls-eye, 18 inches × 8 inches.

Vertical black lines, and the upper and lower ones enclosing the centre, 2 ins. broad.

APPENDIX V.

By adding 10 per cent. to the number of bulls-eyes, centres, and outers obtained by 166 men, at the 200, 250, and 300 yards' ranges, the following figures are obtained:—

At 200 yards,	161 bulls-eyes,	301 centres,	255 outers.
„ 250 „	114 „	224 „	290 „
„ 300 „	82 „	181 „	271 „

By calculating the area of the proposed 2nd class target, and by comparing it with the actual 3rd class target, I find that—

The proposed outer	= $\frac{1}{4}$ actual outer	+ $\frac{2}{3}$ actual centre.
„ centre	= $\frac{1}{3}$ „ centre	+ $\frac{1}{2}$ „ bulls-eye.
„ bulls-eye	=	$\frac{1}{2}$ „ „
„ dead portion	= $\frac{3}{4}$ „ outer	

By applying these proportions, the following data are obtained:—

At 200 yards, shots striking proposed	outer	= 64 + 200	= 264
„ „ „	centre	= 101 + 80	= 181
„ „ „	bulls-eye	=	81
„ „ „	dead portion	=	191
At 250 yards „ „	outer	= 73 + 150	= 223
„ „ „	centre	= 74 + 57	= 131
„ „ „	bulls-eye	=	= 57
„ „ „	dead portion	=	= 217
At 300 yards „ „	outer	= 75 + 132	= 207
„ „ „	centre	= 66 + 45	= 111
„ „ „	bulls-eye	=	= 45
„ „ „	dead portion	=	= 223

From the above I calculate that each man at 200 yards, firing five rounds standing, should obtain—

1·59 outers	= 3·18	points.
1·09 centres	= 3·27	„
·48 bulls-eyes	= 1·92	„
1·15 blank hits.		

At 250 yards a man firing five rounds standing, ought to obtain—

1·34 outers	= 2·68	points.
·78 centres	= 2·34	„
·34 bulls-eyes	= 1·36	„
1·30 blank hits.		

But if a man kneels, his shooting should be 20 per cent. better, therefore he should obtain—

1·60 outers	= 3·20	points.
·93 centres	= 2·79	„
·40 bulls-eyes	= 1·60	„
1·56 blank hits.		

At 300 yards, firing five rounds standing, a man ought to obtain—

1·24 outers	= 2·48	points.
·66 centres	= 1·98	„
·27 bulls-eyes	= 1·08	„
1·34 blank hits.		

And if he fires lying down, his shooting would be 20 per cent. better; he should therefore obtain—

1·48 outers	= 2·96	points.
·79 centres	= 2·37	„
·32 bulls-eyes	= 1·28	„
1·60 blank hits.		

At 350 yards, I assume that a man standing will fire 10 per cent. worse than he would at 300 yards; but he would fire 20 per cent. better if he fired lying down; therefore at 350 yards, a man lying down, will fire 10 per cent. better than he would at 300 yards standing, consequently he would obtain—

1·36 outers	= 2·72	points.
·72 centres	= 2·16	„
·29 bulls-eyes	= 1·16	„
1·47 blank hits.		

To sum up—

Range.	Conditions.	Outers.	Centres.	Bulls-eyes.	Blank hits.
200	Standing	3·18	3·27	1·92	1·15
250	Kneeling	3·20	2·79	1·60	1·56
300	Any position..	2·96	2·37	1·28	1·60
350	Any position..	2·72	2·16	1·16	1·47
		12·06	10·59	5·96	5·78

In round numbers, 6 outers + 3 centres, 1 bulls-eye, 6 blank hits, = 16 hits = 28·61 points.

APPENDIX VI.

1st Battalion. 15th Regiment. Experimental Firing.

REGISTER OF TARGET PRACTICE.

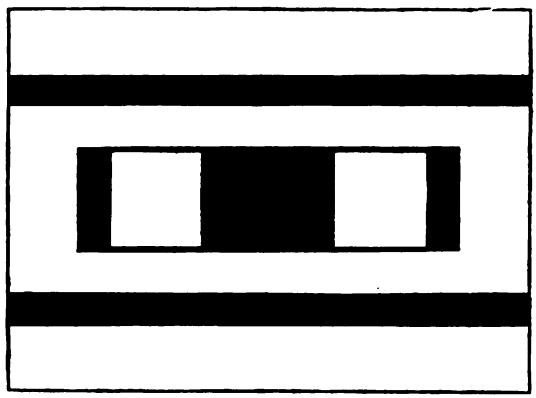
2nd Period. 2nd Class. Number of Targets fired at, 2.

Dated at Alderney, 1st April, 1874.

No. as per Practice Return.	Rank and Name.	1st Practice. 200 yards. Points per shot.						2nd Practice. 250 yards. Points per shot.						3rd Practice. 300 yards. Points per shot.						4th Practice. 350 yards. Points per shot.						Total points in period.
		1	2	3	4	5	Total points.	1	2	3	4	5	Total points.	1	2	3	4	5	Total points.	1	2	3	4	5	Total points.	
1		H	0	H	3	3	6	3	3	3	3	2	14	H	H	0	H	4	4	2	0	H	0	R	2	26
2		3	H	4	4	2	13	H	2	H	2	2	6	H	2	2	4	2	10	2	2	2	2	2	10	39
3		3	3	3	2	R	11	3	3	2	2	2	12	2	H	3	2	3	10	2	3	0	R	2	7	40
4		3	2	2	3	3	13	2	3	3	3	H	11	2	2	2	0	2	8	2	2	2	2	2	10	42
5		3	3	H	H	4	10	3	2	4	4	2	15	0	2	H	3	2	7	H	0	0	3	H	3	35
		Total..........					53	Total..........					58	Total..........					39	Total..........					32	182

Average points .... 36·4

APPENDIX VII. 1st Class Target, 6′ × 8′.



Range.	*Conditions.*
400	Kneeling.
500	Any position.
550	„
600	„

Centre inside measurement, 3′ × 8′.
Central bulls-eye, 18″ × 2′.
Outer bulls-eyes, each 18″ × 2′.
Horizontal black bands, 6 inches broad.

1st Battalion. 15th Regiment. No.____Company ________________ Squad or Section.

FORM C. W. O. No. 923.

REGISTER OF TARGET PRACTICE.

3rd Period. 1st Class. No. of Targets fired at, 4.

Dated at Alderney, 23rd *April*, 1873.

No. as per Practice Return.	Rank and Names.	1st Practice.						2nd Practice.						3rd Practice.						4th Practice.						Total points in the period.
		400 yards.						500 yards.						550 yards.						600 yards.						
		Points per shot.					Total points.	Points per shot.					Total points.	Points per shot.					Total points.	Points per shot.					Total points.	
		1	2	3	4	5		1	2	3	4	5		1	2	3	4	5		1	2	3	4	5		
		2	3	H	H	2	8	3	5	2	3	0	13	3	0	2	2	3	10	4	3	R	3	3	13	44
		2	0	H	0	2	4	5	0	0	5	3	13	2	2	0	2	4	10	2	2	2	5	2	13	40
		H	2	0	H	H	2	0	0	0	3	4	7	5	5	3	4	3	20	4	2	3	2	5	16	45
		H	3	4	3	H	9	2	3	2	R	2	9	0	0	2	3	3	8	3	5	3	3	2	16	42
		2	3	4	H	3	12	2	0	5	2	3	12	3	2	3	2	3	13	R	4	R	2	3	9	46
		2	H	2	H	3	7	2	2	3	3	5	15	4	2	3	0	3	12	3	4	2	4	3	16	50
		R	H	0	H	H	0	2	4	2	2	R	10	4	4	3	2	3	16	2	5	0	R	2	9	35
		2	3	0	2	3	9	5	2	2	4	3	16	2	2	2	5	R	11	4	4	2	4	0	14	50
		Total..........					51	Total..........					95	Total..........					100	Total..........					106	352

______________ { No. ____ Company Marker.

I certify that these practices were conducted strictly in accordance with the Musketry Regulations; that the targets were examined by me before and after the firing at each distance took place, and that the points recorded were obtained by the men opposite whose names they appear.

______________ { *Signature of the Company Officer superintending the Practice.*

______________ { No. ____ Company Marker.

I certify that these practices were conducted strictly in accordance with the Musketry Regulations; that the targets were examined by me before and after the firing at each distance took place, and that the points recorded were obtained by the men opposite whose names they appear.

______________ { *Signature of the Company Officer superintending the Practice.*

OFFICERS.

1st Battalion. 15th Regiment. No.______ Company__________________ Squad or Section.

FORM C. W. O. No. 923.

REGISTER OF TARGET PRACTICE.

3rd Period. 1st Class. No. of Targets fired at, 4.

Dated at Alderney, 24th April, 1874.

No. as per Practice Return.	Rank and Names.	1st Practice.						2nd Practice.						3rd Practice.						4th Practice.						Total points in the period.
		400 Yards.						500 Yards.						550 Yards.						600 Yards.						
		Points per shot.					Total points.	Points per shot.					Total points.	Points per shot.					Total points.	Points per shot.					Total points.	
		1	2	3	4	5		1	2	3	4	5		1	2	3	4	5		1	2	3	4	5		
		0	2	4	3	4	13	5	2	3	5	3	18	4	2	3	2	3	14	2	3	R	3	5	13	58
		H	4	H	3	H	7	2	3	3	4	2	14	4	3	0	2	2	11	R	5	2	R	5	12	44
		2	4	2	H	0	8	2	0	2	5	5	14	3	4	2	3	3	15	R	2	4	0	5	11	48
		H	H	3	4	4	11	3	4	3	4	4	18	2	2	2	5	3	14	0	3	5	0	2	10	53
		2	H	H	0	3	5	2	2	0	4	2	10	4	2	5	2	5	18	0	R	0	2	R	2	35
		H	H	H	2	H	2	5	2	2	0	2	11	3	2	3	5	2	15	0	5	2	3	3	13	41
		Total					46	Total					85	Total					87	Total					61	279

____________________ { No.______ Company Marker.

I certify that these practices were conducted strictly in accordance with the Musketry Regulations; that the targets were examined by me before and after the firing at each distance took place, and that the points recorded were obtained by the men opposite whose names they appear.

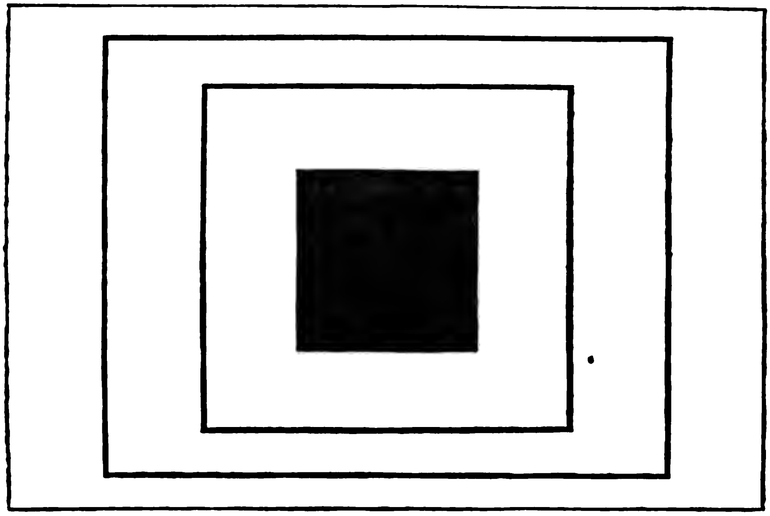
____________________ { *Signature of the Company Officer superintending the Practice.*

____________________ { No.______ Company Marker.

I certify that these practices were conducted strictly in accordance with the Musketry Regulations; that the targets were examined by me before and after the firing at each distance took place, and that the points recorded were obtained by the men opposite whose names they appear.

____________________ { *Signature of the Company Officer superintending the Practice.*

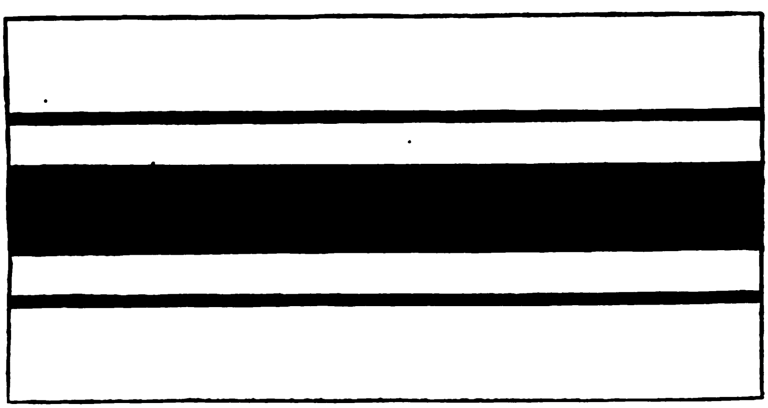
APPENDIX IX. MARKSMAN'S TARGET 8′ × 12′.



Range in Yards.
650
700
800
950

Bulls-eye, 3′ × 3′.
Outer bulls-eye, 5′ × 6′.
Centre, 7′ × 9′.

APPENDIX X. TARGET FOR VOLLEY FIRING 6′ × 12′.



Range.
200 yards.

Conditions.
2 rounds standing.
3 „ kneeling.

Centre.
(inside measurement)
3′ × 12′

Bulls-eye.
18″ × 12′

The CHAIRMAN having announced to the meeting that a discussion was invited upon the various suggestions made in the lecture, and having pointed out two or three of them which were more especially worthy of attention,

Colonel THESIGER said: I was very glad to be able to oblige Captain Brooke by reading his lecture, but I am anxious to mention that I have had nothing whatever to say to the experiments he has made; and although it may perhaps appear a little ungrateful to criticise some of the points he has brought forward, at the same time I am sure it is what he himself particularly wished, that there should be a full discussion on all the important points which he has brought to notice.

I think the most important point which Captain Brooke advocates is, that vertical accuracy must be considered more than lateral. The target which now-a-days troops, either advancing to the attack of a position, or defending it, will have to fire at, will generally be a long line of men at tolerably close intervals. But the height of that target will never, except under very extraordinary circumstances be the height of the target now given to our men to fire at, namely, six feet; therefore, I think, now that we have the Martini-Henry, with a very low trajectory introduced into the service, it would be a very great advantage if the necessity of vertical accuracy were more impressed upon our men, and the height of the target were diminished to four feet. I would not, however, diminish its superficial area but I would simply turn on its side the present 3rd class target, and, instead of making it six feet by four, I would advocate, until further experiments decide as to whether it is necessary to give so much breadth, that it should be four feet by six. The target that men usually have to fire at when on active service, is only about two feet high, but it would be better to begin by degrees and not reduce it too low lest the men should be disheartened at not being able to hit it at all. No doubt, on first commencing to teach the recruit how to shoot, the great point is to make him feel that he can hit a target, and it is therefore advisable to give him a big one; but after he has become a trained soldier, teach him to fire at the sized target he will be certain to find when in action.

As to the "any" position, which Captain Brooke advocates, I think it would be rather confusing to have men advancing to the attack putting themselves into all the extraordinary positions you may see adopted at Wimbledon. The only position that really could be allowed with any chance of keeping men in anything like order would be the lying-down position on the stomach. If you once allow a man to lie on his back, the difficulty of getting up from it, and the difficulty of getting himself into it, would tend to confuse, and the Captain of the company would lose that control which is of the greatest importance now-a-days in advancing to an attack.

Everybody, I think, admits that 600 yards should be the maximum distance at which, as a rule, soldiers should fire, and I believe that much effect would very rarely be produced by firing at longer distances, except perhaps at artillery or at large bodies of cavalry.

A very valuable proposal of Captain Brooke's is that the number of hits should be valued more than the number of points. Unquestionably, a man who is on the target continually is far better than the man who merely flukes a certain number of bulls-eyes or centres; and if any plan could be introduced into our musketry practice which would produce this result, it would, I feel sure, improve that vertical accuracy which is so important.

The skirmishing practice is, no doubt, extremely important, and some experiments have been made in India by the present Commander-in-Chief exactly in the direction which Captain Brooke advocates. At the beginning of last year, at five or six different stations, a line of shelter-trenches was dug, and on the top were placed earthen pots, two feet in diameter, painted white. The regiment was placed 800 yards from them in attack-formation, and advanced, firing upon this position, being reinforced gradually by supports and afterwards by the reserves. No greater proof is required to show how important it really is that vertical accuracy should be more insisted upon than these experiments. At some of the stations at which this practice was carried out, actually only two per cent. of the shots struck the target aimed at! and the highest number that struck was eight per cent.!! Altogether the average at the five or six stations only reached five per cent., 95 per cent. of shots going over the target. This practice shows that the soldier when he is brought to fire at

unknown distances at a smaller target than he has been accustomed to,—but with none of the disadvantages which we meet with in war, such as being fired at himself, which would not steady him or make him shoot straighter,—can only put five shots in every hundred into the front line of a defensive position.

I have no doubt that musketry practice ought to be carried on in heavy marching order; as, if not so practised in peace-time, men would, when on service, either shoot worse, or else get rid of the encumbrance on the first opportunity.

There is another point regarding musketry-instruction, which is, that it takes place for so short a time in the year,—fifteen days altogether,—and then the man perhaps never fires a shot again, except he enters into a company-match or fires for some prize. If our men were only drilled fifteen days in the year, and never allowed to be practised again at it, they would not be very steady in the ranks, and so it can hardly be expected that a man who only fires for one fortnight in the year, when the time comes round for him to fire again, say after twelve or perhaps fifteen months, should prove himself that steady, certain shot, which is the object of all musketry-training. If some change could be made in this respect it would be an advantage.

I cannot agree that the value of independent firing is not so great as it was, and I would deprecate the suggestion that it should be done away with altogether. My own view has always been that a certain number of companies of each battalion when advancing to an attack must always be kept together in line; and as far as I read Von Scherff, he certainly lays down that such small bodies will not suffer a greater loss in that formation than if they were spread over a larger space in skirmishing order. If our troops are allowed to get into that confusion which results from repeatedly reinforcing, where each Captain only has one-eighth of his men in front of him, we shall never be able to extricate them from any difficulties they may get into, or obtain from them their full value as soldiers. I believe these views are now more generally entertained than they were, and, therefore, if you keep a company together as a company in line, even if somewhat opened out, still independent firing will be required. It would be a great pity to lay down that we are going to give up the formation in which we have always been successful hitherto, at all events until we find that we cannot adapt the present requirements of war to that steadiness which is our characteristic.

There is one point, not introduced into Captain Brooke's paper, which I am anxious to say a few words upon. Is it any longer necessary to give money prizes for soldiers firing? You do not give money prizes to the man who is a good drill or gymnast—why then for shooting well? It was no doubt advisable at first to give the soldier some encouragement, but I really think the time has arrived when a man should go through the musketry course as part of his duty, and should not be paid, as it were, to fire well. It would tend very much to prevent that demoralizing effect which, to a certain extent, such a practice has introduced by tempting those who have the power to falsify registers, and to obtain by undue means, either for their companies or for themselves, a larger number of points than have been actually made. I believe a better gauge of the firing of the army would be obtained if prizes were done away with. Every encouragement should be given to company matches, as, I believe, everybody who belongs to a regiment will admit that when the men are competing amongst themselves for a company prize, everything is carried on with the greatest regularity, and it is always certain that the best man wins. I am afraid, however, from the result of our experience in the annual musketry-practice in the Army, that it is not always the case that the man who gets the prize is the man who really made the largest score.

The thanks of the meeting were then voted to Captain Brooke for his suggestive lecture, and to Colonel Thesiger for his kindness in reading it.

Evening Meeting.

Monday, February 1, 1875.

VICE-ADMIRAL R. COLLINSON, C.B., Vice-President, in the Chair.

NAMES of MEMBERS who joined the Institution between the 19th January and 1st February inclusive.

LIFE.

Salmond, F. M., Captain 21st R. N. B. Fusiliers.
Bayley, J. A., Major late 52nd Regiment.
Heathcote, C. Geo., Lieutenant 5th Fusiliers.

ANNUAL.

Swale, John L., Captain 7th Hussars.
Darwin, S. C., Lieutenant R.N.
Hoste, D. E., C.B., Colonel R.A.
Le Grand, F. G., Captain R.M.L.I.

THE UNSURVEYED WORLD, 1874.

By Staff-Commander T. A. HULL, R.N., Superintendent of Charts, Admiralty.

"From constantly comparing maps and charts, and noting the progress and direction of discovery, Columbus was led to perceive how much of the World remained unknown, and to meditate on the means of exploring it."—*Washington Irving.*

IT has been remarked by a modern historian, in reflecting on the brilliant deeds and stedfast valour of our sailors during the wars of Napoleon, that the Navy of this country was destined to rival in the annals of the world the celebrity of the Roman Legions.

But it is not in deeds of arms alone that these distinguished bodies of men are rivals. As in old time "out of the eater came forth meat, and out of the strong came forth sweetness,"[1] so out of the horrors of war come arts essential to the blessings of peace. To insure the success of their warlike designs, both Roman soldier and English sailor added considerably to the future comfort and safety of humanity—the Roman, by making roads; the Englishman, by constructing charts.

What roads are to the soldier, charts are to the sailor, and it is easy to prophecy that England's charts will acquire a greater fame than even the Roman roads.

All of you who are accustomed to drive, know the comfort of a good road, on a dark night. Raise that comfort to the highest power of which your imagination is capable, and you will have some slight idea

of the solace that a trustworthy chart is to the captain of a ship in a dark night and in a gale of wind.

But charts, like roads, require constant attention and repair. The roads made by the Romans in Great Britain gradually fell into decay, and the attempts that were now and then made to repair them were insufficient to prevent England falling into a worse state with respect to its highways, than most other European countries.

It is to arrest a similar decay in the charts of our ocean highways, that I have, with the kind permission of the Council, ventured to intrude myself on your notice this evening.

It is, I am sorry to say, too often the fashion when matters do not go quite as we like them, for us Englishmen to find fault with the Government of the day, when the blame really lies upon our own shoulders. The zeal, ability, and management displayed by the various Hydrographers have been most severely taxed in struggling against the rigid economy which the people of this country desired to have carried out in the public service. I am therefore most anxious this evening to persuade my audience to take an interest in this, to Englishmen, important subject, and request their representatives in Parliament to increase the scientific vote, so that the surveying wants of the nation and mercantile community may be promptly carried out.

I flatter myself that I may be successful, for as far back as January, 1873, I detected a slight turning of the tide, when a leader in the *Daily News* pointed out that although our mercantile Navy had steadily increased from 4 to 7 million tons, our surveying forces had as steadily decreased. And yet the Hydrographic Office is in a great measure self-supporting, as the sale of our charts and books is very large, and might be made larger, by using the ordinary mercantile means of increasing the size of an establishment, to meet the wants of the customers.

In December, 1873, the letter of Sir Bartle Frere, in reply to one from Mr. Gladstone, on the Arctic Expedition, came to cheer and encourage the Surveying Service; one portion of it so fully sets our case in its true light, that I must ask you to allow me to quote it.

After a short preamble, Sir B. Frere writes as follows:—

"You will, I am sure, pardon me for taking exception to the expres- "sion in your letter which indicates an opinion that voyages for survey "or discovery are not strictly 'professional naval services.' I believe "that in these days, when it is so difficult to find a seaman's training "for our young Officers and men, when so much of the work is done by "machinery, there are few better naval schools than a surveying "ship; and that, if such ships were multiplied, not only would com- "merce benefit, but your men-of-war would be better supplied with "practical seamen, both among men and Officers, than is possible at "present.

"This is still more the case with regard to any Arctic voyage of "discovery. Service in the Arctic Seas, under any conditions, is one "of the best possible schools for seamen, and is one of the few schools "which now remain by which a thorough seaman can be formed, quite "equal to the best men of former days.

"Moreover, as a matter of fact, some of our very best practical "Officers are men who distinguished themselves in Arctic exploration; "and I doubt whether there is a single hour of any Arctic voyage of "discovery which, in a strictly professional point of view, may not "be considered well spent as training for any naval service."

I hope, Sir, to be able to show how correct were Sir Bartle Frere's assertions.

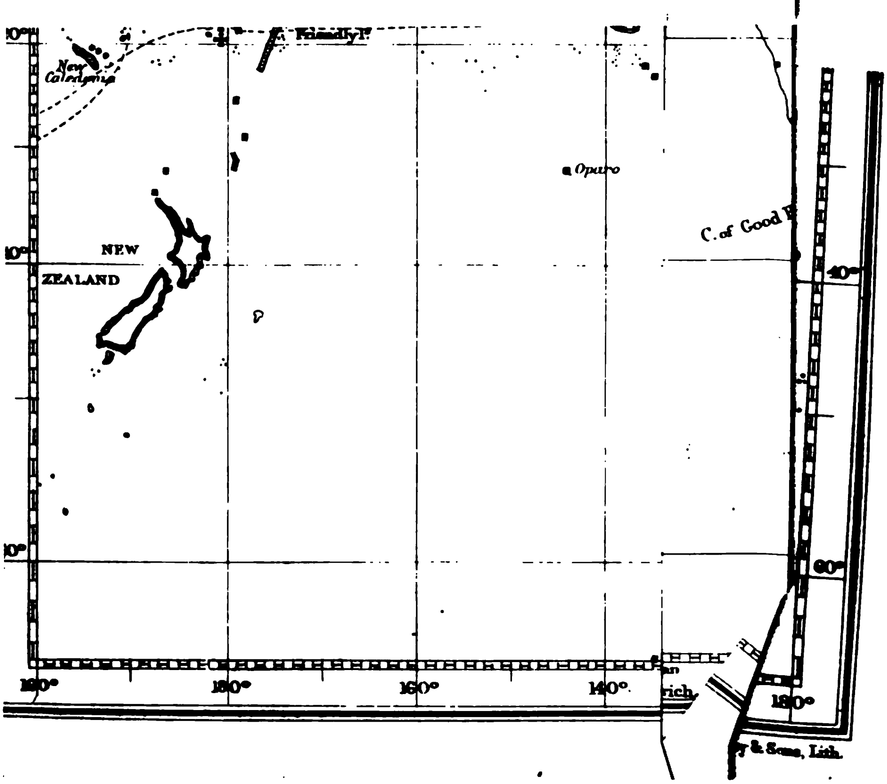
The above letter called forth another vigorous article from the *Daily News*, in January, 1874; while the *Geographical Magazine*, edited by Mr. Clements Markham, one of the Secretaries of the Royal Geographical Society, in an able article in the April number, on the "Hydrographical "Department of the Admiralty," called attention to the reductions in the scientific force. In the July number a similar article on the "Indian "Marine Surveys" showed that although it was one of the obvious duties of a country with an extensive seaboard and a great seaborne trade, to provide for the safety of the vessels which frequent her ports, by the provision of lighthouses and buoys, and above all, by the preparation of reliable charts and sailing directions, yet nothing had been done for a space of 12 years for the coasts of our Indian Empire.

It was thus that the change in public opinion, acting upon a mind I fear more enthusiastic than intellectual, nerved me into drawing up this paper, and constructing the chart before you.

On this outline chart of the world I have endeavoured, by means of colour, to depict, faithfully, the present state of hydrography; and I fear that there will be little difficulty in showing that the title given to the chart, is a correct one. The surveyed coasts are coloured *red;* those only partially surveyed, *blue;* while coasts that have merely been explored, are coloured *brown.*

On the small chart (Plate II) which accompanies this paper however, the shores, marked by a *heavy coast line*, are pronounced to be surveyed; the *shaded* coasts are only partially surveyed, *i.e.*, although the charts of those regions answered tolerably well for the time when they were made, modern progress, steam, and the increase of shipping, require that these coasts should be more thoroughly examined. A large portion of the chart is drawn only in *fine outline;* this indicates that such portions have not been *surveyed;* they have been merely *explored*. The bridle-paths or log-roads of the ocean, cut and laid with wonderful energy and ability by such men as Dampier, Cook, Vancouver, and others, whom Froude has well spoken of as "England's "forgotten worthies." They are forgotten, perhaps, by the many, but well-known to a few, who, although feeling themselves very far the inferiors of these Vikings in ability, are nevertheless animated by the same earnest wish to do their work at home and abroad fearlessly, against all risks, and to whom such sailors become patterns worthy of even the faintest imitation.

In the chart, from the vastness of the subject, I fear many errors will be detected by sailors knowing the respective coasts; I shall only be too glad to find that there should be more thick coast line upon the chart, but I trust no one will be able to remove that line, or the shading.



Friendly I.
New Caledonia
NEW
ZEALAND
Oparo
40°
60°
180°
160°
140°
& Sons, Lith.

The ships upon the chart show the stations of the three regular surveying vessels at present in commission; the crosses show the head-quarters of Officers stationed on shore, doing their best with hired boats and crews. The large cross in the Bay of Bengal, represents the Indian Marine Survey, lately established by Lord Salisbury.

Marine surveys are carried on, either by regular men-of-war fitted for the purpose, or by small hired vessels with hired crews, the latter being adopted where practicable, with a view to economy. I will, therefore, first call your attention to the surveys at present in progress, taken chiefly from the Hydrographer's report to the Royal Geographical Society in May last.

First, there is the "Shearwater," under Commander Wharton, lately employed upon the east coast of Africa, and in taking the Transit of Venus-observers from the Cape to Rodrigues. The "Nassau," under Lieutenant Gray, is still working upon the east coast south of Zanzibar, where their labours have lately been rewarded by the discovery by Navigating Lieutenant J. Dixon of a fine harbour; and the "Sylvia," stationed in Japan, where Captain St. John and his able assistant, Navigating-Lieutenant W. Pearce, are ordered to survey the southern coast of Nipon. The half ship, on the east coast of England, represents the "Porcupine," wherein Staff-Commander John Parsons, with two assistants and a hired crew, have been closely sounding the approaches to Harwich; the work extended from Orfordness to the Naze, and included seaward as far as the Shipwash and Gunfleet Sands. A similar close examination of the shores from the South Foreland to Dungeness was made; the soundings extending from the coast from three to five miles. Dover Bay was also surveyed in close detail, in anticipation of the proposed harbour-works, in continuation of the Admiralty Pier.

Staff-Commander D. Hall made during 1873, in addition to local surveys of the Medina River and Cowes Roads, a minute examination of the bar at Portsmouth Harbour. This survey, consequent on the dredging operations of 1871–2, shows that the proposed depth of 20 feet at low water ordinary spring-tides, has, with the exception of a few spots of 19 feet, been realised. The completion of this valuable channel into our great naval arsenal cannot be overrated. Up to 1863, a line-of-battle ship was obliged to discharge her guns in order to proceed from Spithead to Portsmouth Harbour; now any ship, drawing 25 feet, can enter at three-hours' flood, and the heaviest draft ship at high water.

East Coast of Ireland.—Staff-Commander Kerr and two assistants, in a small hired steamer, have made a patient examination of the off-lying shoal banks between the Tuskar Rock and Wicklow Head. The changes that had taken place in these banks, since their survey in 1844 by the late Captain Frazer, have been of sufficient importance to navigation to demand this re-survey, and to necessitate their re-buoyage, a work now performed by the Commissioners of Irish Lights.

An examination of the bar at Wexford, at Kingston Harbour, the bar of the Liffey River, and the new cutting through the bar of Lough Carlingford, formed also a portion of the season's work. Gratifying

Tunis are surveyed as far as the Gulf of Kabes; the coast, then, with the exception of the harbour of Tripoli, is little better than explored or unsurveyed until we reach Benghazi; thence to Alexandria it may be called partially done, while from Alexandria to Iskanderoun, we are again upon a well surveyed shore.

But I will not weary you with a description that I fear would be tedious; to make the paper, therefore, more interesting, we will return to Plymouth, take ship, and go a voyage round the world, noting as we sail along, the surveyed and unsurveyed shores that we pass.

Madeira and the Canaries may be considered as done; the Cape de Verd Islands, however, require further examination; on reaching the coast of Brazil, we first anchor at Bahia, a surveyed port, with however some unexamined shoal-ground on the western side of the entrance.

Pushing onward to Rio we are still on the black line. Leaving that beautiful harbour, we enter a partially-surveyed region until we come to the River Plate, of which a survey is much required; it was patched a few years back by Lieutenant Dawson working in a gun-vessel detached for the purpose; the French and Americans have also contributed portions, but it has never been fairly surveyed throughout.

The partial survey of Admiral Robert FitzRoy carries us next to Cape Virgins. In mentioning the name of FitzRoy, I must pause to admire how much was done by this earnest surveyor, who with comparatively small means, and in an extraordinarily short time, mapped the Continent of South America from the River Plate in the Atlantic, to the River Guayaquil in the Pacific.

Admiral Sir Francis Beaufort, in his return made to the House of Commons in 1848, remarks, "That all that is *immediately wanted* of "these shores has been already achieved by the splendid survey of "Captain Robert FitzRoy."

I call your attention to the important words "*immediately wanted*," that was upwards of a quarter of a century ago, before the days of steamships, 375 feet long, and before the Strait of Magellan was the high road to the Pacific Ocean.

Rounding Cape Virgins, we enter the Strait of Magellan. Excellent charts, constructed by Captain R. Mayne, R.N., and his able Lieutenant Francis Gray, carry us safely onward for 110 miles, when we again enter the shaded or partially surveyed ground. After passing the southern bend of the straits, the "Royal Naval Reserve" comes to the assistance of the Hydrographic Office, in the person of Lieutenant S. T. Lecky, a worthy Fellow of the Royal Geographical Society, and a Captain in the service of the Pacific Steam Navigation Company. This gentleman, ably assisted by Officers whom he had trained to the work, has furnished us with a running survey (that would reflect credit on any Admiralty Surveyor) extending from Cape Cross-Tide to Cape Pillar, a distance of 100 miles. In his last voyage he made several valuable corrections and additions to our charts on the coast to the northward of Cape Pillar. I may here mention that Captain Lecky acquired his knowledge of nautical surveying when in the service of the Honourable East India Company.

We should like to continue our voyage by the inner channels leading northward of Magellan; but there are orders from the owners against using these partially surveyed waters, and we are reluctantly forced into the Pacific (an ocean by no means worthy of its name in the vicinity of Cape Pillar), with a loss of fuel and comfort, and with great wear and tear to ship and engines.

Captain Mayne's work combined with that of Captain Lecky (whose survey enabled the Hydrographic Office to connect the detached works of King and FitzRoy), supply a tolerable chart of the Strait of Magellan; but the rapidly increasing traffic of large and powerful steamers through this great connecting link between Europe and the western coasts of America, points urgently to the necessity of completing the survey of Magellan Strait, and the channels northward to the Gulf of Peñas.

Pursuing our course along the coast of Chile, whose increasing trade with this country would be much benefited by better charts, we touch at Valparaiso, Callao, and Payta; but it is not until we reach the River Guayaquil that we are in the vicinity of a coast, of which we possess reliable charts. From Guayaquil to Panama we are on the dark line, and, therefore, venturing nearer to the shore, we can coast along one of the most beautiful and interesting parts of the globe; passing La Plata Island, where Drake divided the spoils of the *Cacafuego* in 1579; Gallo Island, where Pizarro drew the line on the sand, over which thirteen of his followers crossed; this famous round dozen believing in their leader; Gorgona, the pleasant island to which this same leader retreated after leaving Gallo, and whence he sailed to conquer Peru.[1]

Entering the Bay of Panama we pass the beautiful Pearl Islands, which have been well described as a perfumed archipelago, lying like baskets of flowers on the tranquil surface of the ocean. To the eastward lies the Gulf of San Miguel, where Balboa, after a journey of twenty-five days across swamps, rivers, and woods, which had never been passed but by the straggling Indian, took possession of the Pacific Ocean in the name of the King of Spain and the Indies. Memories of old times and scenes are a little running away with me, but there is really a great advantage in being able to keep close to these shores, for not only is the current favourable in the passage to Panama, but as it is a branch of the cold Peruvian Stream, a pleasanter temperature is enjoyed than when farther from the coast.

I must, however, in justice, observe that rains are at all times frequent, and that our trip should be so timed as to pass this coast in the fine season when, as old Dampier says, "the rains are more moderate than in the wet season, for then it pours as out of sieve."

Pausing at Panama, let us reflect upon the advantage to English commerce of continuing the survey (so well begun, by Sir Henry Kellett between Panama and Guayaquil) from Guayaquil to Cape Pillar at the entrance of the Strait of Magellan. The trade of this part of South

[1] Mr. Clements Markham, in his "Reports on the Discovery of Peru," published by the Hakluyt Society, believes sixteen to be the correct number, including the pilot Ruiz, who returned to Panama to obtain another vessel.

America has increased in a marvellous manner, through the great revolution which the introduction of steam has made in the system of transport of goods by sea. The enterprise of the Pacific Steam Navigation Company has diverted the trade from the Isthmus of Panama towards the natural channel of the Strait of Magellan. So successful has been this new current of trade, travel, and commerce, that the Company's fleet of magnificent steamships barely suffices to meet the demands of the extraordinarily developed commerce of the South Pacific.

In a statement of the steam companies engaged in the trade of the Pacific Coast, from a Report made by the Statistical Office of the Republic of Chile, Valparaiso, 16th September, 1874, we read as follows:—Pacific Steam Navigation Company, 56 steamers; South American Steamship Company (native line), 10 ditto; German, "Kosmos," 6 ditto; Belgian, 4 ditto; White Star Line, 4 ditto; Compagnie Générale Transatlantique, 3 ditto;—total, 83 steamers. The steamships of the first-named company made 45 voyages from Liverpool and back, the gross receipts being stated at three million dollars for cargo; nearly 2,000,000 dollars for passenger-, and 120,000 dollars for postal-service. Altogether 524 voyages on the coast, and 124 to Europe were made by the various steamers enumerated. This year the depression in financial centres has led to some of the above lines being withdrawn from the trade on this coast, and the Pacific Steam Navigation Company have largely reduced the number of steamers employed on their line *viâ* the Straits of Magellan, the sailings now being fortnightly in lieu of the weekly service carried on last year.

The annual cost of carrying on the survey of the coast of South America would, I believe, be about £14,000 a year, a little less than you willingly allow to be spent on some experiment in shipbuilding that may, or may not succeed; while of the success of this survey, there can be no doubt, for not only would you be constructing charts for the benefit of the mercantile navy; but, as I shall presently show, you would be establishing a first-class finishing school, which, in giving your Naval Officers the opportunity of putting into practice what they had learned at Greenwich, would enable them more efficiently to protect the trade they were helping to create. From the praiseworthy efforts which the Chilian Government are now making to improve our charts of their coasts, I feel sure of their assistance and co-operation in this work. They would be only too glad to send their Officers to school in our vessels, and thus, after a few years, we should be able to carry out the dream of a political economist and "let the Chilians survey "their own coasts."[1]

Looking northward from Panama, there is much work to be done. The rising trade of the Central American ports calls for more attention to coasts, of which, when to the northward of the Gulf of Fonseca, we have little information since the days of Malaspina in 1794. I am glad to be able to state that during January we received American

[1] In the "United Service Gazette," of 30th January, it was stated that the Naval Department of the Chilian Government had organised three hydrographical explorations on the coast of Chili.

surveys of the coast and Gulf of California which will enable me to shade those shores.

In the North Pacific Ocean, that centre of commerce, the Sandwich Island group, is, I regret to have to point out, unshaded. Our chart of that group is said to be "from various but imperfect authorities." Captain James Cook who, considering his short stay, gave us, in 1778–9, a good exploration; and the United States exploring expedition in 1841, added to our knowledge of this archipelago. Something better is, however, required in 1874.

But I must push on from Panama, or we shall not get round the world to-night. From Panama, we shape our course for Tahiti; passing the Galapagos, which may be considered as sufficiently well surveyed for the time, we come next to the Low Archipelago in which the three symbols are blended. What is first wanted here is to examine certain tracks which ships are likely to follow in their passage from Panama, or Valparaiso, through these dangerous patches of coral. The comfort such a road would give to the sailor is something beyond a landsman's understanding. Leaving the beautiful and famous Tahiti, where you will all remember Captain James Cook observed the Transit of Venus in 1769, we pass on through the Friendly Islands and Fiji archipelago. Here reliable charts are much wanted to clear away the doubtful dangers of this part of the Pacific, which render the nights of the captain as uncomfortable as those of a parish doctor in a poor neighbourhood. He is always being called, has to turn in all standing, which means in plain English, going to bed in his boots.

Many of my hearers will remember the graphic account of the discomforts of shipwreck among the Fijis given by the Earl and the Doctor. Their schooner was, I think, wrecked near the Exploring Isles in the eastern part of the group.

Commodore Goodenough, ably assisted by his industrious Navigating Officer, Lieutenant Hosken, is doing his best to improve our charts of this archipelago; but his praiseworthy efforts show only too clearly how much a surveying vessel is required in Melanesia.

Refreshing ourselves at Sydney, we next push northwards for Hong Kong; our course lies through portions of the ocean similar to those we have already passed; our charts of this part of the world may be said to be, in a great measure, supported by voluntary contributions. Captain Simpson and Navigating-Lieutenant Greet, in the "Blanche"; Navigating-Lieutenant Tilly, of the mission schooner "Southern Cross"; and lately Captain John Moresby and his navigator, Lieutenant Mourylian, have all sent additions to our charts. Captain Moresby has been very energetic on our behalf,—obtaining first the services of Navigating-Lieutenant Conner, of the Queensland Survey, and latterly those of Lieutenant Dawson, our itinerant surveyor of the south-western Pacific;—he has been enabled, through these Officers, to forward considerable information regarding the shores of New Guinea; following up the discoveries of Bougainville and Dentrecasteaux, Captain Moresby has charted about 300 miles of the hitherto almost unknown western coast of this island, and has made important additions to the Admiralty charts. Notwithstanding, however, the

efforts of these worthy contributors, our captain's anxieties are not decreased, and it is not until we get to the northward of the Carolines that he can, for a season, divest himself of his boots.

Our passage is now more free from dangers. Passing through the Bashee Channel, we enter the China Seas, refreshing ourselves at Hong Kong. Leaving that port, we observe an absence of shade to the eastward, and traders between Hong Kong and Sydney would be grateful for better charts of the Mindoro Straits and the passages through the Philippine Islands. Coaling at Singapore, we hear that merchantmen are asking for better charts of the Carimata Strait and the Java Sea.

Entering the Indian Ocean, by the Straits of Malacca, our next port will be Point de Galle. I will here pause to thank Mr. Clements Markham for calling attention, in his Magazine of July last, to the state of the Coasts of India, little having been done to the charts of this important portion of our dominions since 1862, when the Indian Navy ceased to exist; and the charts, copper-plates, and original drawings were transferred to the Admiralty. Mr. Markham tells us "it was suggested, but not agreed to, that the future surveys of the "Indian Coasts should be conducted by the Royal Navy." The very few surveying ships that the Admiralty were allowed to equip had other work to do, the Imperial Treasury having no intention of paying for Indian surveys.

You will be pleased to hear that Lord Salisbury has here come to our assistance, and that a surveying force, consisting of five sailing vessels taken from the marine service at Bombay and Calcutta, will at once be established. Each sailing vessel will be supplied with a steam pinnace, and there will be one steam tender; the flotilla will be officered by one Staff-Commander, three Navigating-Lieutenants, two Navigating Sub-Lieutenants, with Mr. R. C. Carrington, late first-class draughtsman of the Hydrographic Department, as Chief Civil Assistant. This force has been organized by, and will be placed under the superintendence of a well-known Indian Officer, Commander A. D. Taylor, who will do his best to restore the efficiency of the old Indian Marine Surveys, and make provision for the fast-increasing commercial necessities of British India.

From Galle we proceed to Aden, and up the Red Sea. I regret being unable to mark the shores of this sea with the dark line. A beginning has, however, been made; Captain Nares has surveyed the Gulf of Suez, and Lieutenant Gray the small Strait of Bab-el-man-deb; but I have little doubt the trade through the Suez Canal will enforce this work. Thanks to Monsieur Lesseps, we need not leave our vessel, but may steam into the Mediterranean where, not to weary you farther, we will land at Brindisi and ruminate over what we have seen and heard. This voyage round the world will have given you an idea of how much is required to be done. We will next consider who there is to do it.

I fear if I pipe "Chart-makers to muster," there will hardly be sufficient for the work, especially if we look to the main line of the Navy, where only two Captains, one Commander, and two Lieutenants

can be found who may be called qualified to command surveying ships. The Retired Lists would add some four or five Officers to our forces, but I fear their services are no longer available. In addition to these Officers, there are nine Staff-Commanders and three Navigating-Lieutenants, who may also be in some measure qualified; for it must be remarked that, it having for some time past been considered expedient not to give Navigating Officers the command of surveying ships, they can be employed only as leaders of detached parties. Their instructions are to charter small craft in the colonies, and, with a hired crew and one or two assistants, work round the little circle of which their head-quarters is the centre.

This detached system chiefly recommends itself by its cheapness, and as an auxiliary force is, I admit, not without value; but it tends to isolate the Surveying Service from the general service, and naturally inclines the Officers connected with it, to feel *colonial* rather than *imperial* interests.

Another disadvantage of these detached parties is, that we lose that grand school for practical nautical surveying, viz., a ship and the disciplined life of a man-of-war, where alone a young Officer can acquire the combined knowledge requisite to qualify him for a profession in which the duties of the *sailor* can by no means be neglected. No man can expect to attain a trusted position as a Nautical Surveyor who is not essentially a good Officer and sailor, or, to speak more exactly, a good Pilot, knowing how to handle a body of men, the requirements of a ship, and the room she wants to wear, stay, or anchor in. This knowledge cannot be acquired in, what a naval paper has well termed, "the one-man-and-a-boy system" of nautical surveying.

It was with great regret, therefore, that, in the middle of 1873, men, like Sir Bartle Frere, who took an interest in this important branch of the Navy, saw it had fallen so low that there was only one regular surveying ship in commission, viz., the "Shearwater," under Commander Wharton, then on her passage from the survey of Sicily to assist in the Zanzibar expedition.

The "Challenger," Captain Nares, was, it is true, also in commission; but she must be looked upon rather as an exploring than as a surveying vessel; at the same time, under Captain Nares, and his indefatigable Chief of the Staff, Staff-Commander Tizard, a school was formed from which the best results may be expected,

The total number of Officers employed at this time, July, 1873, was, including the "Challenger's," 36, of whom four only belonged to the main branch of the service, *i.e.*, there were only one Captain, one Commander, and two Lieutenants among the number.

Let us now go back for a quarter of a century, to 1849, the days of Sir Francis Beaufort, when the public took a greater interest in the Surveying Service. We find that there were no fewer than 12 surveying vessels in *commission*, in addition to 23 Officers, borne on ships' books for detached Surveying Service.[1] At the same time the Arctic

[1] If in 1849 a full list of "Officers employed on surveying service" had been

force (the "Challenger" or additional scientific force of the period), numbered three ships, exclusive of the "Erebus" and "Terror."

I have here a list of Captains and Commanders, who in 1849 might have been considered qualified to have taken charge of a survey. The number is a large one, viz., 17 Captains and 12 Commanders: as the names are tolerably well known, I think reading the list will interest many of my hearers.

Captains.	Commanders.	Surveying Ships of 1849.
Barnett.	Bate.	"Acheron."
Bayfield.	Bedford.	"Avon."
Belcher.	Drury.	"Bramble."
Beechey.	Frazer.	"Columbia."
Bullock.	Orlebar.	"Comet."
Collinson.	Nolloth.	"Herald."
Denham.	Otter.	"Pandora."
FitzRoy.	Richards.	"Rattlesnake."
Graves.	Shortland.	"Royalist."
Kellett.	Spratt.	"Scorpion."
Owen.	Williams.	"Sparrow."
Sheringham.	Wolfe.	"Volage."
Stanley.		
Stokes.		
Sulivan.		
Vidal.		
Washington.		

It will be observed that I have given a list of Captains and Commanders only, omitting the Lieutenants and Masters employed in 1849; many of whom were also qualified to command surveying ships.

I have taken 1849 by chance. I am not sure that it was a year in which the Surveying Service was in a particularly flourishing state: 1873 was a bad year, the minimum was arrived at of *one ship;* a fact, cruel enough to arouse the shade of Sir Francis Beaufort; and it is easy to imagine that veteran Surveyor upbraiding his countrymen, and saying, with Cæsar Augustus, "Oh, Varus, restore me my legions."

I will next proceed to show that these ships of 1849, as schools, produced not only Nautical Surveyors, but superior Officers for the general service.

Take the "Acheron," commanded by Captain John Lort Stokes, then surveying New Zealand; in this same "Acheron," the late Hydrographer, Admiral G. H. Richards, was Commander, and Chief of the Staff; the present Hydrographer, Captain Evans, was the Master, and his present Chief Naval Assistant, Staff Commander Pender, a Master's Assistant.

The Captain of the "Encounter," Richard Bradshaw, the Officer at first especially selected to take the observers for the coming Transit of Venus, to Kerguelen Island, was also a Midshipman in the "Acheron."

given, similar to the one in the present Navy List, it would have included upwards of 80 names.

Take the "Herald," then, with the "Pandora," surveying the great Bight of Panama, under Captain Kellett and Lieutenant James Wood. The Captain of the "Herald" is now Sir Henry Kellett, K.C.B., lately Commander-in-Chief on the important China station.

I may here remark that the present Commander-in-Chief in China, Sir Charles Shadwell, K.C.B., Fellow of the Royal Society, was First Lieutenant of the "Fly," Captain Sir F. Blackwood, during the survey of the east coast of Australia and Torres Straits; while Admiral Ryder, the future Commander-in-Chief in China, received his early education as a sailor and navigator under Captain Richard Owen, in the "Thunder," the surveying ship in the West Indian station in 1833.

Returning to the "Herald," her First Lieutenant was Rochfort Maguire, who finished his career as Commodore of the Australian station. The Second Lieutenant commanded one of the Arctic ships in 1853. The Master of the "Herald," after leaving that ship, served as Master of Sir George Seymour's flagship in the West Indies. Of the Midshipmen, one died as Captain in charge of an Australian Survey, one has lately retired after commanding two surveying ships in succession; another is Captain Bedford Pim, who I am pleased to find on becoming M.P. has by no means ceased to be R.N., or forgotten his nine years' service in H.M. Surveying Service; and last and least of the old "Herald's," is the humble individual who has the honour to address you, then a Master's Assistant, now Superintendent of Admiralty Charts.

I have taken two instances only out of the surveying vessels of 1849; I am sure that most of them would tell a similar tale. Sir John Glover, of Ashantee fame, was serving about that time as a Mate on board the "Volage," then surveying in the Mediterranean.

There is another interesting branch of the profession of Nautical Surveying, which becomes of the greatest value to our merchants in this age of submarine cables; I allude to deep sea soundings, and to an examination of the bed of the ocean for the purpose of laying those useful communicators. On the 1st of June last year, at a meeting of the Royal Geographical Society, the wall of the theatre of the London University was covered with diagrams, showing how much work the "Challenger" had done in deep-sea sounding. Great was Lord Howe's victory of the 1st of June, 1794 (a day never to be forgotten by the English sailor), and the memory of the day was well kept in 1874, by exhibiting the trophies of a victory over the elements of which Captain Nares may no less be proud. By the diagrams Dr. Carpenter illustrated an instructive paper, and I believe, proved the correctness of some of his ingenious theories.

Many of you know the care, forethought, and experience required in "overcoming the mechanical difficulties[1]" of obtaining an accurate deep-sea sounding. Sounding was ever a most important point in a sailor's profession. Upon the accuracy of the soundings engraved on the Admiralty chart, the character of the Nautical Surveyor mainly

[1] A phrase used by some of our philosophers, who, although knowing a few of the secrets, cannot be said to comprehend the mystery of the sea.

depends, for while the land work may be done by the soldier or civil engineer, the sounding is the sailor's portion, requiring all the ready wit and tact of his profession. In sounding, the sailor has to manage air and water, the rise and fall of the tides, the velocity of currents, and to fit in his work to suit wind and weather; these forces becoming firm allies to the man who studies them, and foes only to him who knows not how to use them.

Readers of Marryat will remember the Master of the old war time was often called "Soundings" by his shipmates. The name might not have been meant as a compliment, but it nevertheless was so. This prime duty of a Nautical Surveyor is now of more value than ever. Telegraphic Engineers not only require accurate position and depth of water, but also samples of the bottom of the sea at great depths, they want to know what kind of bed their cables are to lie upon, and this information can be obtained only by sounding.

I am glad to observe that the part of Sir Bartle Frere's letter, showing the advantages of an expedition to the Arctic seas, has been attended to. The fact of our last Arctic Expeditions having brought to the front such men as McClure, McClintock, Maguire, Richards, Osborn, Armstrong, and Nares of the "Challenger," may lead us to hope that the present attempt to place the Union Jack on the northern meeting of the meridians, may bring into notice another body of English sailors, who shall worthily fill the place of those now passing away, and I feel sure none will ever regret again raising the cry of "Northward Ho!"

But there is one more point I should like to call your attention to, and that is to another body of men the Surveying Service has brought into notice; a class that many (and probably with good reason) would esteem more highly than the simple sailor; I allude to naturalists and botanists; and when I assert that such men as Darwin, Hooker, and Huxley, began their celebrated careers in Her Majesty's surveying and exploring vessels, I hope the public will think it worth while to restore the old practice of appointing a naturalist to surveying ships, on the chance of securing men of such undoubted value to the scientific world.

Professor Wyville Thomson's staff, now qualifying themselves for these important duties by sea service in Her Majesty's ship "Challenger," leads us to hope that the surveying vessels of the future will carry a naturalist, as in the days of Sir Francis Beaufort; and I was much pleased to observe in Captain Taylor's scheme for re-establishing the Indian surveys, that he pointed out the advisability of again appointing to every surveying vessel a Medical Officer, who is also a naturalist, and giving him encouragement and opportunity to pursue his scientific tastes.

I trust, Sir, that I have now fully proved the correctness of the assertions of Sir Bartle Frere, in his letter to Mr. Gladstone, viz.: "That "there are few better schools than a Surveying ship; and that if "such ships were multiplied, not only would commerce benefit, but "our men-of-war would be better supplied with practical seamen."

We have now considered what may be termed the out-door work of the Surveying Service. We must next turn to the in-door portion.

The harvest may be plentiful, the labourers hardworking and willing, the corn is cut and stored, but before we can use it for food, it must be threshed, ground, and made into bread. As with corn so it is with nautical surveying. The work comes home, it has then to be given to the world in the shape of Admiralty charts.

This distribution of knowledge is placed in the hands of the Hydrographic Office of the Admiralty, which unfortunately, through the rigorous system of economy insisted upon by the public, has not been permitted to advance with the times.

The number of charts increases yearly, the work required is more finished and elaborate, the demand and sale of the charts also increases, but there is no corresponding increase in the Staff employed. In the beginning of 1874 the Office suffered two considerable losses, the late Hydrographer, Admiral Richards, being carried off to the chair of the Telegraph Maintenance Company; while the Japanese Government induced one of our best draughtsmen (holding through the present rules of the Civil Service, with regard to age, a junior appointment, but who had actually served four years in the Scottish Survey, and ten years at the Hydrographic Office), to leave £150 per annum in England for £1,000 per annum in Japan. At the end of the year, we also lost our first class draughtsman, whom Captain Taylor persuaded to join the Indian Marine Survey; as, however, this loss to us will be gain to India, we can console ourselves by knowing that Mr. Carrington is only serving the Indian instead of the Imperial Government.

Without entering into the general work of the Hydrographic Office, I will venture to make a few remarks upon the particular and important branch of the Department over which I have the honour to preside.

The old surveyors, who are present, will, I think, quite understand the mingled feelings of pride and diffidence which I experienced last year when (on the death of my much lamented predecessor, Captain Hoskyn, who may fairly be said to have died at his post) Admiral Richards placed me as Superintendent of Admiralty Charts in the chair once occupied by Michael Walker. The difficulties before me were not so much to improve the present, as to be equal to the past.

I found myself most ably supported by the gentlemen of the Admiralty Chart-Room, or room in which the charts are prepared for publication; but until I had fairly entered upon my new duties, I had failed to realize the maximum of work which this branch of the Office had managed to perform, with a minimum of hands.

An inspection of the Admiralty Chart-Room would prove the truth of the assertion of the *Daily News* in January, 1873, that "space is wanted "to spread out a chart, without having first to remove books or papers "that are at the same time under consideration." The place is rather suggestive of a midshipman's chest, and it is only from a sailor's luck of having been educated in a midshipman's berth and used in thus

"being cabined, cribbed, confined," to utilize every atom of space, that one is able to cope with this difficulty.

The number of charts at present published by the Admiralty is in round numbers 2,500, a large number of which are continually under correction, for changes in lights and buoys, alterations in leading marks, *i.e.*, beacons, natural or artificial, that lead through channels to clear submarine dangers.

These corrections, although small, require the greatest care and experience to make them; for if such *important simplicities* are neglected, and the chart be incorrect in these essentials, no finish or cunning engraving can save its credit; it is beauty without discretion, a danger "instead of a safeguard to the sailor who uses it. "Any draughts-"man," says Sir Edward Belcher, "can make a neat showy plan, but it is useless if it cannot stand the seamen's test." As a very slight error in the position, colour, and character of a light or buoy, or in the insertion of a simple dot, cross, or figure may lead to the gravest disasters, every mark upon an Admiralty chart must be delineated by the Hydrographic Draughtsmen with the greatest care, and no pains are spared by these gentlemen in their endeavour to attain—where it is possible—mathematical exactness, and to lay before the public the labours of the nautical surveyors, explorers, and amateurs, not only of England, but of the civilized world; reducing their various styles into a comprehensive system, and thus furnishing the intelligent seamen with an intelligent guide, which common industry will soon enable him to thoroughly appreciate.

For instance, there are no fewer than 3,710 lighthouses and light-vessels in the world; these lighthouses and light-vessels are generally surrounded by, what we will term for illustration, a large family of buoys. Let us take a well-known place, "the Downs," or speaking of watering-places, that part of the coast of England between Broadstairs and Dover. Here we have 3 lighthouses, 4 light-vessels, and about 20 buoys, or nearly 3 buoys to one light; from this we may premise that there are considerably over 9,000 buoys that have to be inserted upon the Admiralty charts.

Notices of changes in lights and buoys abroad require careful translation by some one who not only understands the language, but also the subject under consideration. Here we miss the talented draughtsman before-mentioned, who, in addition to his other qualifications, was also a surveyor and an accomplished linguist.

Again, copper plates, when much used, actually wear out; 4,000 impressions taken from the same plate in four years is a trial even for copper. On an average, it may be stated that, allowing for each plate the constitutional three score and ten years, no less a number than 36 plates a year have to be re-drawn and re-engraved to keep up the stock. In addition to the above, new surveys require new plates; these average from 40 to 50 a year, making a total of about 80 fresh plates that are required yearly.

Sir Bartle Frere's address of 1874 informed the Royal Geographical Society that during the past year 77 new charts had been engraved and published; 1,620 sheets had received corrections and additions; and

the number of charts printed for the Royal and Mercantile Navies and use of the world had been 187,248.

All MSS. and published hydrographic matter received from foreign Governments has to be examined and compared with the published charts, to see if they can be improved therefrom; and in this duty alone considerable labour and experience are required.

The above constitutes an amount of work which the present staff of a chief draughtsman and five assistants, is not equal to, and the result is, that the unpublished information is steadily accumulating.

It may now be asked, "But what will the new College at Greenwich do for us?" This question will, I am sure, be answered to your satisfaction this day fortnight, when my friend Mr. Laughton will read us a paper on the outline of the studies at the Royal Naval College. My own experience, as an Examiner in Nautical Surveying at the College, encourages me to hope that it will recollect that it is educating men who are to be sailors themselves, and direct the labours of other sailors. Greenwich cannot educate the whole Navy, it can but select those Officers best fitted to make use of the advantages it offers. In those men, the College aims at developing the keenest intellectual insight, readiness, and strength, *but*—and there is as much virtue in this *but* as in Touchstone's *if*—*but* I say not (in the case of Surveyors) at the expense of their fingers.

Charts have to be projected or built. Our Surveyors will do this more craftily and swiftly, and with more delicacy and precision, with the help of higher mathematics; but a wilderness of $x + y$ will not assist a man who cannot use scale and compasses. Greenwich, therefore, while aiming at the highest, forgets not the lowest.

Emerson, commenting on the success of Napoleon, points out in how great a degree it was due, to his never thinking the smallest detail unworthy of the most careful consideration; he could draw up an attractive A B C for the King of Rome, as well as the orders for a score of brigades. "It is a five minutes," said the Emperor, "that "wins a battle."

Darwin, himself a sailor, somewhere remarks that, as a man's intellect increases, his instinct decreases. Sailors must not be educated so highly that they lose those instincts which are the real cause of our naval supremacy. Remember that the success of the sailor and pilot depends upon a thorough and *ready* knowledge of the many important simplicities of his calling; such knowledge necessarily endows him with that promptness in action, and fearlessness in conduct, for which members of his profession have ever been distinguished.

The public must remember that while the Greenwich students are acquiring the valuable power of handling books and instruments, they should not lose the not merely valuable, but absolutely invaluable power of handling men and ships. Modern theorists seem to have forgotten that the great use of education is to enable man or woman to earn their living honestly in that station on board the ship of life, unto which the Great Commander-in-Chief has seen fit to call them. A sailor's education, more than any other, requires *time*. The late Head

Master of Rugby, and present Bishop of Exeter, Dr. Temple, speaking with large experience as a schoolmaster, remarks, "that the indis-" pensable condition of success in self-culture is *time*"; but it is just this condition which is most signally wanting in modern education. The student of our day must almost of necessity acquire knowledge in a hurry, bolt it in fact (a bad process for mind as for body). He must learn much, not in order to retain it and make it (to again quote the Bishop) "part of his understanding," but in order that he may be able to throw it up, when under the ordeal of the examination room.

The College will furnish the understanding of its students with arms, but its labours will be thrown away unless the country gives the students a ship in which they can exercise those arms. The knowledge acquired at Greenwich is a force to be used at sea.

You have Greenwich ashore; to complete the business you must have Greenwich afloat. No occasion to build a ship; there are plenty at hand; take a vessel like the "Endymion," remove a few guns to give space for a chart room; call her the "Greenwich," and send her to sea with her seniors drawn from the College, her youngsters from the "Britannia" (possibly it might be advisable to send the youngsters to the "Greenwich" before the "Britannia").

Let her be commanded by some general service man, in whom might be found the united qualifications of sailor, navigator, and gunner, with a staff composed of a known Nautical Surveyor, and two assistants. Send her to work at some blank portion of the Unsurveyed World, say—the Pacific. The Fiji or Sandwich Islands will form a healthy field for her labours, the passage out affording time for the usual drills, for, as before remarked, the duties of the sailor and gunner must by no means be neglected. Under the good Providence she would return in some five years time, not only with a cargo of charts, but with men, who in becoming professors had not ceased to be sailors. For it is in ships only that men can discover the "Secrets of the sea," and it is not with an egotistical, but with a self-reliant spirit that I quote Longfellow, and maintain, when speaking of the sea, that—

"Only those who brave its dangers
Comprehend its mystery!"[1]

"Ships for sailors" must be the cry of our New Greenwich. Let us learn from a well-known character, Mr. Wackford Squeers, of Do-the-Boy's Hall, who, when he had taught a boy to spell "window" after his own peculiar fashion, viz., "w-i-n, win; d-e-r, der; win*der*," at once dispatched him to go and clean it, this he termed the "practical" mode of teaching, the regular education system."

Do not, therefore, fall astern of Do-the-Boy's Hall, but when your sailors have learnt the theory of Nautical Surveying, give them a well-

[1] *Specimen of the Ideas of Men who do not Comprehend its Mystery: cut from a weekly paper.*

"A suggestion is made to establish telegraph cable stations on the high seas, "built upon buoys, at which a steamer may stop and communicate if in "distress, give in her time, and enable her passengers to communicate with their "friends on either shore."

found, and well-manned, man-of-war to go and practise it, by making charts of some portion of the Unsurveyed World.

I have thus endeavoured, in the best language I can command, to set before you the present wants not only of Her Majesty's Surveying Service, but of the mercantile world, and ask you to bestow upon this service a little care, attention, and money you give so freely to ship-building and experiments therein, and great gun-founding; for let ships and guns be perfection, they are useless unless you have skilled men and trustworthy charts, to conduct your floating castles with confidence and security.

In conclusion, I appeal to many in this theatre who are fortunate enough to possess the ear of the public, and beg of them, if this paper has found favour in their sight, to assist in establishing, on its proper footing, a service not alone useful in peace, but also terrible in war. The old Napoleon's collection of maps was probably the best then in existence; with these and his compasses he planned the destruction of the Austrian forces, and what he had warily conceived in the Tuileries, he executed in the field with the celerity and force of a thunderbolt. Similarly, the success of Naval operations often depends upon the correctness of the charts, coupled with the power the sailor may possess of constructing and using them.

I would, therefore, call attention to the necessity of giving Naval Officers early opportunities of putting into practice afloat what they have learned on shore; doing, it may be said, at Austerlitz what they have planned in Paris.

Finally, I entreat you all to let this branch of Her Majesty's Service be so well recognized, as a useful element in the Empire, that it shall be in some measure protected from those blasts of ruinous economy which periodically sweep over our country; remembering that, from its first establishment, the Surveying Service has been "*second to none*" in placing and maintaining the Navy of Great Britain in its prominent position among the forces of civilization.

The CHAIRMAN: Before I call upon you to join with me in returning thanks, I have no doubt there are many gentlemen here who would like to make some observations upon the interesting paper we have just heard. Captain Shortland, I believe, is present.

Captain SHORTLAND, R.N.: Our lecturer has said what he has to say so extremely well that there is very little to be added. We surveyors know the difficulties that Officers, who are called upon to survey, have to contend with. They do not generally have the best ships given them, nor are their labours so well understood by those who have not followed surveying as by those who have, like our worthy chairman and myself perhaps. We know that we have fallen very much behind-hand lately in the numbers that have been employed, and the encouragement given to us has not been very great as far as my experience goes. I hope that the people in power, taking up our worthy lecturer's paper, will carry out some of his views and bestow a little more attention to a subject that so well deserves their best consideration. I quite believe that surveying ought not to be *departmental*, but it ought to be considered *national*. It concerns the whole nation that we should have good charts, especially as our commerce is so very large and is extending every day. If our merchants understood that, it would be the best mode of lessening the insurance on their ships, and I do hope this will be understood in order that the House of Commons may be impressed with the necessity of expending a little more money on works which are

so useful and essential. However, all I have said is so obvious to everyone, that it is hardly necessary for me to say it.

Lieutenant STIFFE, late Indian Navy: I wish, in the first place, to bear testimony to the great ability and knowledge of the subject shown by Captain Hull, and to the trouble he must have taken in getting up that chart. I think, also, the thanks of the public are due to him for drawing attention to the very important subject of the deficient state of our knowledge. For several reasons, lately, hydrography has been at a discount, and it has really seemed to me that the race of hydrographic surveyors was going to become extinct altogether. The chief countries that have had to do with hydrography have been England, France, and America. Since the civil war in America, there has been very little done there. In France there has been also a collapse during the last few years, owing to the war; and, in England, although the difficulties have only been financial, yet that has apparently been as effectual as any other cause, and we have come down it seems, at one time, to one surveying ship, which is rather an unpleasant state of things to contemplate. I would also mention the abolition of the Indian Navy, to which I had the honour to belong, and the dispersion of the trained group of men that belonged to the surveying branch of that service, has also added to the deficiency. We may hope a new era is going to dawn now, and that a House of Commons, more liberal in the true sense, will see the propriety of taking a fresh start in this matter, and enabling England to maintain her proud position at the head of nautical affairs, and rule the deep with lines of soundings in addition to other methods. Of course, unless the public can be got to understand, clearly, and take an interest in the subject, which can only be done in some such way as drawing up such a map as this, it is hopeless to expect any improvement in the matter. I have no doubt many outsiders, on looking at this map, will be rather astonished to see so much *brown* in the map.[1] Doubtless they may have formed an idea that all our maps and charts were models of perfection and completeness, and that everything in print must be correct; and, therefore, they will be surprised that so much remains to be done. But I must confess that on looking at it, to me it is perfectly astonishing there is so much *red* there; when one thinks that hydrography and charts on the present system are a thing people now living can almost recollect the beginning of. The last half century, I suppose, is nearly the whole period, and when one thinks what an expenditure of time, energy, labour, money, and life, even one of our charts often represents, it is perfectly astonishing that so much has been done. The field is obviously very large, and I have no doubt when we have finished the *brown* that is shown there, we shall have to begin again, for the increasing demands of hydrography will necessitate new and more elaborate surveys.

There is one subject Captain Hull has felt obliged to treat very tenderly, namely, the indoor department of the Hydrographic Office. We know it is difficult for a man to complain of the shoe that pinches himself, and it is not much liked. Perhaps an outsider may say something plainer, and I will say that I think the amount of space allotted to the Hydrographic Department of the Admiralty is utterly inadequate to the demand, and is unworthy of a country like this. I must say the first time I went there, 12 or 14 years ago, and was shown into the Chart-Room, I came to the conclusion that there must be suites of rooms, elsewhere, that were not shown to the public, and certainly began to institute a comparison with a private civil engineer's drafting office near Great George Street, where I was then employed, not at all to the advantage of the Admiralty Chart-Room. I must say, how the gentlemen in that department manage to find anything, spread it out for use, or put it away again, is quite a puzzle to me. It must be the result of bringing up from childhood in that office, or I do not see how it is to be done. I think it must be admitted that a large increase in the staff is a *sine quâ non*. There are, Captain Hull states, about 2,500 charts now in use; I should like to know what the percentage of increase is on what the number was 10 or 20 years ago, and what is the comparative increase of the staff to work these charts. When one thinks that the charts of the whole world are manipu-

[1] On the chart exhibited at the lecture, those parts of the world that had only been *explored* were coloured *brown*; the *fairly surveyed* portions were coloured *red*; and the *partially* surveyed, *blue*.

lated and repaired in that small room, it is marvellous how the work is got through at all.

Mr. FORDE: I had hoped I should have been allowed to listen to this interesting paper and discussion without having to speak myself, as I am not very much given to it; but I assure you, being connected very much as I am with submarine telegraphs all over the world, I have listened to this paper with the greatest pleasure, and I hope the result of it will be good for us engineers. We are often called upon to lay cables from one part of the world to another almost at a moment's notice, and the first thing we have to do is to rush off to the Hydrographer's Department to know what information they have as regards the locality in question. In 1861 I was engineer to Her Majesty's Government for a line laid from Malta to Alexandria. Admiral Washington was, at that time, Hydrographer to the Admiralty, and we got the charts from him. They looked exceedingly nice; and, as Admiralty charts usually are, very correct, we had come to the conclusion that we should lay this cable along the coast so as to have it within reasonable depths, as some of the former cables had been lost in deep water. We found, as I have just said, the charts exceedingly pretty, and we imagined that they were very carefully done. I was asked by the Board of Trade to write out instructions for the Hydrographer's Department to have soundings taken, in order to make quite sure of the depths and nature of the bottom, and in order to obtain soundings at much closer intervals than what is usual on Admiralty charts. The Admiralty undertook to make these soundings, and we waited some time for them. I then waited on Admiral Washington and asked him, "Have not you some soundings for us?" He said "Yes, we have "some, but the information is so incorrect, I dare not send it to you." He sent out orders, in the first instance, to Commander Mansell of the "Firefly," then stationed at Alexandria, and he said his soundings were so incorrect, or, at all events, they disagreed so with published charts, that he had telegraphed to Captain Spratt, commanding Her Majesty's ship "Medina," to go and take these soundings. In due course, Captain Spratt sent home his first soundings, when Admiral Washington informed us that they confirmed those of Commander Mansell, and disagreed entirely with the published charts of that coast; in fact Captain Spratt found great discrepancies. Where the charts represented the soundings to deepen gradually from the coast into the Mediterranean, Captain Spratt found they were more like steps of stairs, going down 100 fathoms in the swing of a ship. He spent some time over this, and took partial soundings along the coast from Alexandria to Tripoli, and thence to Malta. I went to Malta to see him, and he told me he had finished that service of four soundings. On examining the charts I told him I wanted a great many more soundings, to which he replied that my request could not be complied with, as he had already burnt too much of Her Majesty's coals in the service of the Company; but when it was explained to him that this was a Government cable, he then saw the propriety of burning more coal, and started off again for the coast, and continued his work for several months longer. It appears to me that the blue colour, on the diagram, is due to Captain Spratt's services on this occasion. One thing occurred to me at that time, and I happened to mention it to the Commander-in-Chief at Malta (Admiral Sir William Martin), and that was seeing there were so many of Her Majesty's ships sailing all over the world, why cannot it be managed to have a sounding taken by each ship at noon; and, in that way, we should soon see the whole globe covered with valuable soundings; which soundings would be more or less a guide to engineers who have to carry out these long cables through deep water. But his answer to that was, "a deep-sea sounding, as we all know, requires to be "taken by a man who has had great experience in the matter, and who has been well "trained to it, otherwise you get false results." Now Captain Hull's paper clearly shows that the nursery for bringing up Officers to surveying has almost been destroyed, therefore we are not likely to have Officers, on board each man-of-war, that are trained to surveying and taking deep-sea soundings. I think, myself, each man-of-war ought to carry an Officer who has been trained in the Surveying Service, just as they would a gunnery-lieutenant. I only hope that this paper may not only be brought to the notice of the Lords of the Admiralty, but that they should, if possible, read, mark, learn, and inwardly digest it, with a view to their carrying into effect Captain Hull's valuable suggestions. The "Challenger,"

no doubt, is doing good service, and will give us a great amount of valuable information both as to the deep-sea soundings and currents, as well as the nature of the bottom. I will only add that this paper is particularly interesting to us as civil engineers engaged in laying cables, and I for one, heartily thank Captain Hull for bringing the subject forward.

Mr. LAUGHTON: I have taken such great interest in the subject of surveying for some time past, that it was with great gratification I learned that Captain Hull was going to bring it forward; it is one to whose needs I am quite sure the country is not awake. If a copy of the chart now before us could in any way be published, as in the fly-sheet of the "Times," the country would be aghast. People look at the beautiful maps issued by Keith Johnstone, and others, and they think that we know the world perfectly: what more can be wanted? They do not know that the outlines given on such maps are to a great extent mere guess-work; the proportion of what is real knowledge and of what is imagination is not known even by well educated men. I most sincerely hope the Government may be able to take the matter up, and that Parliament may find them the means to do so. In our small way at Greenwich I think we shall, in course of time, be able to give a foundation. It is not much we can do with such an entirely practical subject as surveying; but still we can give them the A B C of it, and that we are doing,—I believe, very effectually.

Dr. HIRST, F.R.S.: It was not my intention, Sir, to make any remarks this evening, because I really did not expect to be able to attend your meeting. I have listened with very great pleasure to the paper just read by Captain Hull, and I have naturally been greatly interested in the allusions he has made to the part which Greenwich may play in improving the Surveying Service of the country. There is, I think, but one observation in Captain Hull's address with which I do not heartily concur. His warning against our educating Naval Officers at Greenwich is, I submit, scarcely called for at present. If you take into consideration the small amount of an Officer's time which, under the most favourable circumstances, can be passed at Greenwich, you will, I think, admit—Mr. Darwin would certainly do so—that his sailor instincts are in little danger of being thereby diminished by over-education. Moreover, if you had been in my position this afternoon, Sir, and had seen Captain Johnson's class operating with their sextants and other instruments within the railings of Greenwich College, fixing the positions of gravel walks, by means of angles subtended by lamp-posts: if you had seen these Officers afterwards in their class-rooms laying down said walks and lamp-posts on paper, constructing, in fact, a chart with as great care as if the safety of their instructors, when traversing the Quadrangle on a foggy day, depended upon the accuracy of their work; if you had seen this, I say, you would agree with me that at Greenwich we do not at all neglect those simplicities of a surveyor's work to which Captain Hull has very properly directed attention. We certainly do not attempt to rival "Mr. Squeers" in his mode of imparting a practical training. We do not fall astern of him, however, in the matter of window-spelling, but we look mainly to the Admiralty to provide opportunities for window-cleaning. I believe, Sir, that the studies pursued at Greenwich are without exception those with which every practical man, properly so called, ought to be thoroughly acquainted. I believe that without the intellectual and theoretical training which we endeavour to give, the action of a practical man would be incessantly hampered, and not unfrequently misdirected. I have, therefore, no hesitation in pronouncing all fears as to the character and tendency of the studies pursued by Naval Officers at Greenwich to be perfectly groundless. At the same time, however, I entirely concur with Captain Hull in the opinion that our work at Greenwich requires supplementing in the manner he has advocated. Operations conducted in the Quadrangle, and even extended by means of the "Arrow" and our steam launch to a short distance down the Thames are, of course, insufficient to make a surveyor. To this end the wider experiences which a surveying ship alone can provide are absolutely indispensable. The praiseworthy efforts of our students to master the rudiments of Nautical Surveying at Greenwich, deserve more recognition by the Admiralty than they have as yet received. Such recognition, in the form of speedy employment in surveying ships, would not only be of great service to the College, but would be welcomed by all who are interested in the welfare of our

Surveying Service. We have no less than forty Officers, including Captains, Commanders, Lieutenants, and Navigating Lieutenants, now studying Nautical Surveying under the guidance of Captain Johnson. Last Session we had about twenty such students, and Captain Hull, who was their Examiner last June, was able to report very favourably of their proficiency. At the head of the list stood Commander Grey, an Officer who has well qualified himself for surveying duties, and who will, I trust, soon be actively employed in such. In conclusion, Sir, I may state that I cordially join in the wish, to which expression has been so frequently given this evening, that the Admiralty may be induced speedily to raise our Surveying Service to the high rank it formerly held.

Clements Markham, Esq., C.B., F.R.S.: I, like the rest of the company, have listened with very great interest to Captain Hull's suggestive paper. I cannot help feeling that it may prove to be a turning point; that there is reason to think, from various causes, that the surveying branch of the Naval Service has at last reached its lowest depression, and it certainly will be a very great satisfaction to Captain Hull if hereafter, from this year, perhaps from this evening, we may date the gradual increase of the efficiency of the Surveying Service of the Navy of this country. In the meanwhile other countries are doing a little here and there: and I should like to be allowed to ask, if it is not an improper question, whether, whilst we are neglecting the work that used to be done on a much larger scale twenty years ago, there is any regular system of collecting from other countries all the surveying work which is done, sometimes good and sometimes indifferent, in small patches and in numerous parts of the world. This kind of work occasionally comes to my knowledge, and I have often wondered whether, as a matter of course and regularity, it was received at the Hydrographer's Office. For there is what appeared to me a beautiful little survey of the intricate channels between the Island of Chiloe and the main land. I know of another survey on the coast of Peru, executed the other day. It seems to me that increasingly valuable additions may be made to the charts, by carefully collecting everything that is done by other countries. I see, with some surprise, the whole of the West Coast of South America coloured brown. I fancied that the chart-sheets of that coast were prepared by Admiral Fitzroy, and that it would have received a blue colour. If this is not so, I can conceive no more important work than the completion of the whole of that West Coast by a regular survey, for nearly every small part on it is visited by English steamers. There was one lost only the other day to the north of Callao. Certainly numerous anchorages and bays, which no one would ever have dreamed of entering thirty years ago, are now constantly used owing to the increasing trade in sugar, cotton, and other exports of Peru. I remember myself taking a small vessel into one of the ports of which there was no sign in the chart. There is another part of the chart that shows, I think, too much red, which I think should be reduced. India has no right to have the red completely round her shores, because there are several little bits here and there unconnected, and there ought to have been brown spots in at least three places. A very distinguished civil servant of India recently told me he had, near Cape Comorin, himself opened a cotton port and despatched a ship direct to England from a place entirely unsurveyed, and unknown as an anchorage. I should like very much to see Captain Hull's chart reproduced in large numbers, because very few people can have an idea of the immense tract of coast that is untouched. I certainly had not. I fancied I should have seen the whole of that coast of South America, as examined by Fitzroy, in red; but I only see patches here and there. I am sure we ought to be extremely obliged to Captain Hull for the information he has imparted to us.

Captain Davis, R.N.: As an old surveyor myself, and having been employed on the survey of the coast of Peru, under the late Admiral Fitzroy, I can quite understand why Captain Hull has fixed a brown mark round that portion of the coast that I was engaged on. I consider the survey made of that part of the coast by Admiral Fitzroy to have been nothing more than a pilot-survey—a survey of the greatest utility in his day, when such ports as Mr. Markham has instanced were not even thought of as being of any importance. Admiral Fitzroy pointed them all out in a simple running survey, so that I would not at all make the assertion that the

whole of that coast was properly surveyed. Still, I think Captain Hull might put in a little bit more red.

Mr. TRELAWNY SAUNDERS: I wish to add one word with reference to a practical consequence arising from the breaking up, or almost entire breaking up, of such an establishment as that which was carried on with great success under Admiral Beaufort, and that is the dispersion of a considerable body of trained artisans employed in the engraving of the charts. A body like that is not easily trained; it takes many years of apprenticeship to train them up to the execution of a work of such excellent character as those charts were; and I must say, when one compares the charts of the present day with the charts executed by Admiral Beaufort, I am afraid we must consider that there has been a decline in the art of engraving as represented by the Admiralty charts, rather than an advance. I am quite sure that whenever a very considerable increase may take place in the staff of surveyors, and there is an endeavour to turn to account the large stores of information that remain unused in the Admiralty, a very considerable difficulty will be found in procuring competent engravers, and that is one of the consequences of the economy that has been practised of recent years in the reduction of this important establishment. I think, Sir, before economies are practised in such a way as to disperse trained artisans, the consequences of such economies ought to be calculated and foreseen.

Captain HULL: With regard to the remark by Mr. Forde about the soundings not being found to agree in the Mediterranean, I may say, the soundings he alluded to were done in the days of Admiral Smyth, the great amount of coast explored being creditable to the Admiral, but it was, as Captain Davis has very well remarked, a pilot survey. I have no doubt the soundings of Captain Spratt and, I think, Captain Mansell, will be found to have the advantage of being taken by better trained men, who were able to devote more time to the work.

With regard to what Mr. Markham says of the coast from Callao, I think the work of Admiral Fitzroy's was of a similar character, and in going over it with the assistance of my friend Mr. Powell, the chief draughtsman, we came to the conclusion that, although we should have liked to colour it blue, *i.e.*, "partially surveyed," in justice we were obliged to make it brown, or "only explored."

I had not the least idea of making any attack on the Royal Naval College at Greenwich. I am quite certain the College is moving in the right direction. The remarks in my paper were rather directed towards the British public; I fancied from one or two remarks I had heard lately they were expecting too much from Greenwich; and, with regard to my allusion to Mr. Squeers, I brought him in as a sort of laugh at the public. If Greenwich taught its students to spell "window," or surveying ship, Greenwich could do no more. The public should then find the "window," or ship, to clean or survey in.

With regard to India, Mr. Markham said some part of India was not so well surveyed. I coloured that part of the chart with the assistance of Captain Taylor and Lieutenant Stiffe. Unfortunately I had never been in India myself, but I shall recollect Mr. Markham's remarks, and, when I prepare the chart for the Journal, I will take care that the part referred to shall be amended.

The Falkland Islands were done by Admiral Sulivan. They are very well surveyed, and I think are equal to the wants of the times.

As to the River Plate, portions of that river are surveyed, but they are unconnected. The river has never been fairly surveyed throughout.

The CHAIRMAN: I am sure you will join with me in saying we have had a most interesting lecture, and before asking you to return thanks, I will just make one or two observations. We all are very well aware that the Battle of the Nile never could have been fought at the hour it was, if Nelson had not himself been a pilot. We are also well aware, at Copenhagen he took his own soundings; and, by being able to take his ships in to a close position to the batteries, compelled the result of the action there. I could quote several other Officers, Beaufort, for instance, who, in the course of the war, surveyed Karamania; Heywood, who surveyed the River Plate; but I will allude to one very celebrated Officer. A few years ago I had occasion to consult the charts of Spitzbergen at the Admiralty, and I came upon one, the last publication, corrected and improved by Captain Brook of the "Shannon." Now these are instances I have brought forward especially to call

the attention of the junior Officers, that a knowledge of surveying, in all probability, may materially influence their career through life.

I now would proceed in a few words to allude to the great benefit which the naval and mercantile service derived from the career of Admiral Sir Francis Beaufort as hydrographer. The magnitude of the ignorance was enormous, but, fortunately, we had a man who was equal to the occasion. Under his fostering care, the Officers in the list which was read to you to-night were educated and well brought up, looking to him for his countenance, advice, and support, and always being welcomed back by him with that kindness and affection which is the true source of confidence between employer and employed. I will just allude to these places which are now marked as you see them. My first passage round Cape Horn was in the month of March, fifty years ago, but then I had nothing to do with longitudes. In the year 1827 I arrived at Rio Janeiro with twelve chronometers on board the ship, and we fancied we had fixed the longitude. We returned in another vessel in the year 1835, and we were quietly informed that we were 14 miles in error. Afterwards we went round Cape Horn and tried to carry the longitude up into the Pacific. Our chronometers all went wrong, although we had twenty, and the fact of the matter was that the longitude of the West Coast of South America was not correctly fixed, I suppose, until steamers began to run in 1858. In the course of that voyage one of our objects was to settle the question of the longitude of Mount St. Elias. We sailed from Mazatlan, went up to Cook's Inlet, in lat. 60° N., and returned back to Mazatlan, although we had twenty chronometers, we brought our longitude back to 15 miles in error. That will give you an idea of the difficulty of ascertaining longitudes by chronometers, unless you perform voyages to and fro. In 1840 we found the Island of Chusan 30 miles out in longitude; and, having occasion in 1848, to compare the charts at the mouth of the Hooghly, I found the longitude of the entrance, to that river, 8 miles in error. That will give you an idea of the magnitude of the errors in those days, and what a great amount has been done since that period, and which we mainly owe to the persevering efforts of Sir Francis Beaufort. Captain Hull alluded to the survey in South America on which I was employed, and spoke about the difficulties with the rain, and told you a story about Dampier. I remember, under the same circumstances, Dampier says that it came on to rain; and, by great difficulty, they got some cocoa, but, for the life of them, they could not finish their cups, for it rained so fast.

I think now, Gentlemen, I may ask you to join with me in returning our thanks to Captain Hull for the interesting account that he has given to us, and I am sure you will cordially agree with me in thanking him for the able paper which he has written.

LECTURE.

Friday, March 19, 1875.

COLONEL SIR WILLIAM F. DRUMMOND JERVOIS, C.B., K.C.M.G., R.E., in the Chair.

THE NEW WORKS FOR THE DEFENCE OF PARIS.

By Major E. S. TYLER, R.E.

THE siege of Paris by the Prussians in 1870–71 showed plainly the value of the fortifications round Paris. The German forces, after defeating the armies of France in the field, were stopped in the full tide of victory by the forts of the capital. It was, nevertheless, apparent from this siege, and also from the siege by the Government of France against the Commune, when M. Thiers by a singular stroke of destiny had to besiege the very fortifications he had been mainly instrumental in causing to be built, that the works were not capable of offering due resistance to rifled artillery.

Accordingly, as soon as the place was recaptured from the Communists, the Commandant of the Army of Paris was ordered to direct the engineers to prepare designs for new defences. After being considered by the Committee of Fortifications, the Commission of Defence, and the Army Committee of the National Assembly, a project for a new system of defences was finally adopted last year, and in the autumn the works were commenced.

The ground has been broken on the north and on the south of Paris, and the work is being pushed on vigorously in those quarters. On the east and the west designs have been matured. But as want of money prevents the whole of the work from being commenced at once, it has been determined to postpone for the present the execution of the works on the east and west sides, and to devote all the available resources to the new forts on the north and the south, which will cover the weakest points of the old defences.

The proposal to execute these works was not carried, however, without considerable opposition. There were people, as there always are in such circumstances, who objected to all defences as being likely to invite an attack, and attributed the fact of a siege having taken place to the existence of the fortifications. M. Viollet-le-Duc has expressed this idea very clearly. He says, "Paris fortifié est devenu l'objectif

"des Allemands." "The fortifications have rendered Paris the object "of the Germans." Paris had, however, "become the object of the "Germans" before the existing fortifications were built. The capital of France had no fortifications in 1814, or in 1815, but was nevertheless the object of the Allied Armies. In 1870 Berlin had no fortifications, but the cry of the French was "à Berlin." It is not the works of defence that surround Paris that make that city the object of the enemies of France. It is because Paris is the heart of the country, the centre of the finance and commerce of the nation, and the seat of government.

General Chabaud-la-Tour, the author of the report of the Commission de l'Armée, to which I am indebted for much of the substance of this lecture, replied to the objections to the fortifications of Paris in the Assembly. He said, "The illustrious Lamartine in attacking in "1841 the project for fortifying Paris used these words—'We are "'showing the enemy the point where he can best strike France.' "We replied at that time, that after the events of 1814 and 1815 we "need have no fear that we could teach the enemy anything in this "respect; that history was a more dangerous instructor to him "than the demand to fortify Paris; that we wished to discourage any "enterprise of the enemy against our capital, because the fact, that "Paris was in a condition to resist his attacks, would have a powerful "influence on the defence of the country; that we did not wish to "attract the enemy to the capital, but to keep him away from it."

"Our object," said General Chabaud-la-Tour, "is the same to-day. "We wish, by remedying the defects of our fortifications, to deprive "the enemy of the hope that he may reduce our capital, as in 1871."

The French have indeed abundance of experience to warn them that, as Paris is the centre of all their warlike operations, so is it the point which is most exposed to the attacks of an enemy. Towards Paris converge the valleys which descend from the eastern and northern frontiers to the heart of France. Three times during the present century have invading armies descended those valleys. In 1814, the Grand Army under Schwartzenberg, after overrunning the south-eastern provinces of France, advanced to Paris down the valley of the Seine, and the Prussians under Blucher descended the valley of the Marne. In the following year the Allies under Wellington came from Belgium down the valley of the Oise. Again, in 1870, the Prussians followed the same route along the Marne that had been traversed by Blucher in 1814. If in any future war the armies of France should meet with ill-success in the field, their enemies' forces will traverse once more the well-beaten tracks that lead to the capital, since they well know that victory over the nation is never complete till Paris is taken.

And, since the last war the approach to Paris is much less difficult than it was before. Since the cession of Alsace and Lorraine, the distance to be traversed by an enemy from the north-eastern frontier has been reduced by nearly one-third, the frontier fortresses of Metz and Strasburg have become the bases of operation of the invader. It is true that new works are being constructed inside the restricted

frontier of 1871. New fortifications at Mezières and Verdun on the north, and a great quadrilateral at Epinal, Belfort, Besançon, and Langres on the east, will do much to strengthen the frontier. If, however, the field army be defeated, such fortresses may impede, but cannot stop a numerically strong invader in his advance on Paris.

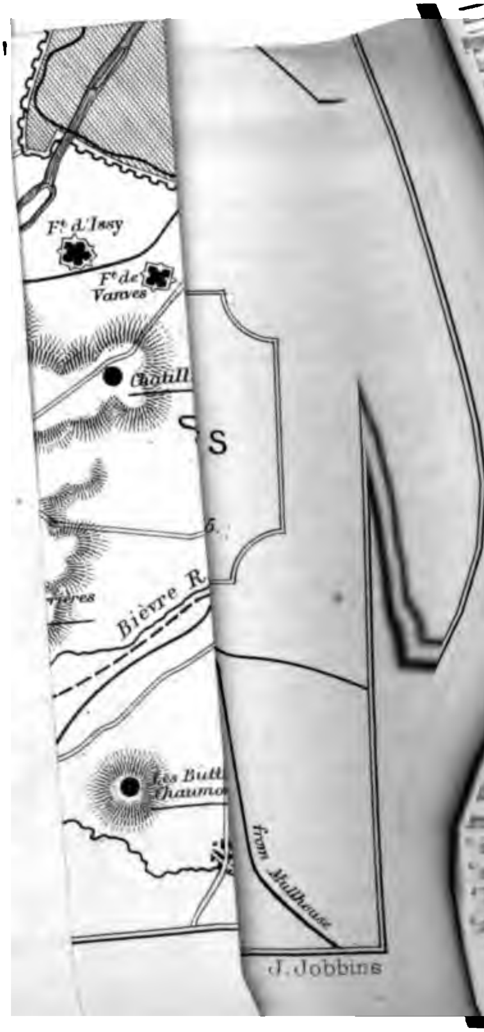
Though the fortifications of Paris did not succumb in the late siege, the incomplete attacks of the Germans demonstrated that the system of defence was not adapted to the conditions of modern warfare.

The advanced forts are so near the enceinte that they do not protect the city from bombardment. They are only 2,000 yards in front of the ramparts, so that the Prussian batteries on the heights to the south of Paris were able to throw shells into the portion of the city on the left bank of the Seine.

It is a remarkable fact, that even when these defences were projected, more than thirty years ago, one engineer raised serious objections to the position selected for the detached forts in the south. General Noizet warned the French Government that even with the limited range of the projectiles of that period Paris might, in spite of the detached forts, be set on fire from batteries on the heights of Chatillon, and he proposed to occupy those heights.

The old detached forts are so placed, that a sortie in force is a most difficult, and in some quarters an impracticable undertaking. On the north the ground outside St. Denis commands the defences of the place, and the investing army of the Germans in 1870, taking advantage of this formation of the ground, intrenched themselves so strongly, that an attack upon their lines could not be made with any hope of success. On the south the heights of Chatillon and Clamart command the forts, and are so clothed with woods and with houses, and so intersected with ravines and enclosures, that the movement of masses of troops is impossible. In the south-west the ground is so broken, that the investing force was able to construct almost unassailable lines of field works and obstacles. On the west and north-west, the windings of the Seine place equal restrictions on the movements of the garrison and of the attacking force. To the eastward a sortie was made with a large force on the 30th November, 1870. Five bridges were thrown across the Marne; 70,000 men were employed. The centre column of attack was directed on Champigny; but the difficulty of assembling large masses of troops, and getting them across the river, was very great; and though the French at one time had gained some advantage, they were eventually compelled to retire.

Moreover, from observatories on the commanding heights on the north and on the south, and also from some elevated points of ground elsewhere, the Prussians were able to watch the besieged so closely that no movement of any considerable body of troops could take place without the besiegers being aware of it. As soon as the garrison were seen to be massing their forces in any quarter, the Germans knew that a sortie might be expected, and were able to begin at once to collect their troops at the threatened parts of the investing lines. A German



Ft d'Issy
Ft de Vanves
Bièvre R.
from Mulhouse
J. Jobbins

writer says, "The preparations for the sorties took place under our 'eyes, so that we were never unready."

The ground round the old works at Paris is, in fact, generally more favourable to the attack than the defence. Good positions for siege batteries abound on the heights of Clamart and Chatillon and on the high ground in front of St. Denis, and the ground in front of the fortifications is well adapted for a blockading force to entrench themselves. Owing to this conformation of the ground the Prussians were able to construct and to guard with success their lines of investment, and it was almost impossible for the French to break through them. Without studying this ground, and the accounts of the singularly complete system of fieldworks and obstacles which the Prussians constructed upon it, it is difficult to understand the want of success of the French in their sorties, or the difficulties which the French encountered in their attempts to break through the lines which surrounded them.

The merits and defects of the defences constructed according to the project of 1840 may be thus summed up:—

1st. They stopped the Prussians.

2nd. They did not save the city from bombardment.

3rd. They did not afford facilities to the garrison to make effective sorties.

The central and most important point of the existing defences on the north of Paris is the populous town of St. Denis, two or three miles outside the enceinte of the place. In front of St. Denis are some bastioned lines of good profile, but without casemated cover, called La Double Couronne du Nord. To the left of the crownwork is a small enclosed work, the Fort de la Briche, lying close to the Seine. To the right of the crownwork is the Fort de l'Est, also a closed work of small dimensions. All these works are capable of resisting an assault, but they are not fit to withstand a serious attack. The exterior defences of the north of Paris are completed by the large Fort of Aubervillers, which is on the flat ground to the right of the Fort de l'Est, and connects the defences of the north with the forts of the plateau of Montreuil, which guard Paris on the east.

Northward of the lines of La Double Couronne the ground rises continuously for miles. The besieger can and did post his batteries within range of the works, on ground higher than the works themselves. The siege batteries of the Prussians opened fire so short a time before famine compelled the French to surrender that the attack of the besiegers was never carried on beyond the stage of preliminary bombardment, but the French, conscious of the weakness of these defences, seem to have attached more importance to the northern attack than the Prussians did. The Commission of the Army say, with truth, in their report, that "St. Denis, with its incomplete defences, "its double crownwork without bomb-proofs, and commanded on all "sides, is not at present in a condition to make much resistance. "The enemy, who was able during the late war to bombard the works "above enumerated, might have established himself on the heights

"that command the place, and thence after subduing the fire of th
"works have pushed on his attack over ground most favourable t
"his operations, till he gained possession of St. Denis. This don
"some of the most populous quarters of the city would have bee
"within range of his position, and might have been set on fire by hi
"projectiles."

A good position farther to the front is not to be found very nea to St. Denis, for the ground continually rises for some miles in front o La Double Couronne, and it is necessary to travel five miles along th main road to Calais and Amiens, before the summit of the high groun is reached. On the left of the road at this distance is a range o heights, and at the highest point of this range the Fort of Domont, large work of the first class, is being constructed. The ground aroun it is covered with woods, a portion of the Forêt de Montmorency which is a series of copses rather than one continuous forest, an stretches away to the north-west of Domont. To the north and north east is a wide valley, with long easy slopes on either side, well see from the fort. The hills on the north and north-east, which woul have to be occupied by a besieger, are very distant, and he coul not commence his operations nearer than the brow of these hills without being seen from the heights of Domont. If he attempte to push forward approaches and make a regular attack on the defences, he would have to advance down hill under the fire of the guns of the besieged. The position is, in fact, favourable to the besieged and difficult and inconvenient for the besieger.

The work at Domont will be supported on the left by a smaller fort, which is about to be commenced at Montlignon, on the top of a high hill, precipitous in rear but sloping gently to the front. This fort will have the Forêt de Montmorency in its front, and will command also the wide valley to the westward, traversed by the Chemin-de-fer du Nord, and by the two high roads which pass respectively by Pontoise and Enghien, and join the great route of Calais at St. Denis.

From the Forêt de Montmorency westward to the Seine, is a lev plain broken only by the sharp ridge, on which are the villages Cormeil and Sannois. This ridge is of such a shape that, if it we in this country, it would probably be called the Hog's Back. It ris abruptly from the plain and forms the chord of the arc made by th bend of the Seine enclosing the peninsula of Houilles.

At Cormeil, at the extremity of the ridge, a large work is bein built, which will secure for the garrison the undisturbed possessio of the fertile peninsula of Houilles. It will command the Forêt de St. Germain and the Lower Seine on its left, and will fire over the wide valley on its right. Though the distance to the fort of Montlignon is $4\frac{1}{2}$ miles, it cannot be doubted that these two works together will prevent an enemy from penetrating to St. Denis by the valley between them. Fieldworks thrown up across the valley, with their flanks well secured and their front swept by the guns of the permanent works, would be unassailable, and an enemy attacking on this side would have to commence operations by a regular siege

of one or both of the works at Montlignon and Cormeil. It was proposed to construct also a work at Sannois, at the inner end of the Cormeil ridge, but this design has been abandoned.

Thus we may consider the line from the Seine at Cormeil to Domont to be secure, and we turn next to the right flank of the main position. The Fort of Domont itself will sweep the hillside to its immediate right, and prevent access by the Calais road. But further, to give general support to the two works in front, and more particularly to guard the right flank of Domont, a fort of the second class is to be constructed above Montmorency, on the southern spur of the Domont-Montlignon heights. This work will connect the advanced forts with the existing fortifications of St. Denis, and with the work at Stains, and will guard the ground about Montmorency, which is higher than that at Pierrefitte and Stains.

To the right of Domont, again, it has been proposed to occupy the hill of Ecouen, and the Committee considered a work there to be indispensable, because the summit of the hill there is nearly 100 feet higher than the fort at Stains. Having regard, however, to the facilities presented on this site for temporary works, it has been suggested that it may be left to be fortified at a time of expected attack, or a permanent battery may be thrown up there. Its distance from Domont is nearly three miles, and it is still further from Stains, the next work on its right. A work here appears to be more urgently required than at Montmorency, and I am disposed to think it would be preferable to construct at once a strong permanent fort of the second order at Ecouen, and postpone the construction of the one to be commenced at Montmorency.

Due south of Ecouen a fort of the second class is being constructed at Stains. This work will command the plain to the north-east, and guard the left flank of the inundations of the Molette and Morèe, extending from Stains by Le Bourget to Bondy, which was of such value to the Germans during the last siege, but will now be included in the line of the defences. It will be remembered that the village of Le Bourget was occupied by the Germans in the last siege, taken from them by the French, and again captured by the Germans after a sanguinary and obstinate combat.

The inundation completes the line of the defences on the north. It is evident that the construction of these new works will enormously increase the difficulties of the besiegers, and will make the besieged powerful both for offence and defence in the quarter where they were formerly weakest. The general design is especially well suited for vigorous offensive action on the part of the besieged, an object which the projectors have kept steadily in view. An army may assemble in security in front of St. Denis, and, debouching with every advantage of ground in their favour on to the great plain to the north-east, may strike straight at the communications of an enemy coming from the eastward to attack Paris.

The Commission of Defence, as before stated, reported that the defences on the south of Paris, as well as those on the north, most urgently required strengthening, and works are being accordingly

constructed on the south. I propose, therefore, next to examine tl general plan of the works now in progress on the south of Pari before describing those that are projected elsewhere.

The defences on the south of Paris constructed in accordance wil the project of 1840, consisted of a line of six detached forts from Fo Issy on the west, to Fort Charenton on the east. They are larg and powerful works with plenty of accommodation for the garrison abundant interior space, and high escarps. But the position the occupy is bad. They are so close to the enceinte that they are onl fitted to act as outworks, instead of playing the important pa assigned in the present day to detached forts. Instead of com manding the ground in their front, they lie at the foot of a range hills. On the wooded and irregular heights of Chatillon a besiege can build his batteries in security, at distances of 1,000 to 2,00 yards from the works. In the hollows and among the copses an farms of those heights the besieger was in the last siege more securel posted and better covered than the garrison in their permanent work

It is indeed creditable to the powers of endurance of the garrison that these works held out against the Germans so long, for they cann be considered capable of resisting a serious regular attack. Tl explanation is, that the Germans had not till nearly the end of tl siege the means of making a regular attack. They hoped by block ading the place to reduce it to surrender for want of food for tl inhabitants, without having to undertake the formidable task of regular siege of permanent works armed with rifled ordnance. An when their siege artillery had arrived, the Prussians thought that the would obtain an easier and quicker victory by bombarding the plac and thus working on the fears of the famine-stricken inhabitants, tha by commencing siege operations against the detached forts. Tl terror inspired by the Prussian batteries on these heights to tl south of Paris, firing into the forts and bombarding all the quarte of the city on the left bank of the Seine, was very great, and will n soon be forgotten by the Parisians.

In selecting a position for the southern advanced defences, it wa not at first sight obvious which was the best position to take up, an it was only after prolonged discussions had taken place, and muc difference of opinion had been expressed, that the plan finally adopte was determined upon.

The idea first entertained, was to occupy the heights of Chatillc with a permanent fort, and to construct a line of works along the hig ground to the right, extending by Chaville to Celle St. Cloud an Bougival. But such a line would have had grave defects, and wou not have fulfilled the objects in view. Versailles would have bee outside the defences, and the great advantages to be gained by tl possession of that place, with all its public buildings, barracks, an stores, would have been lost to the besieged. Moreover, Versaill would have been under the fire both of the forts and of the sieg batteries, and in the event of another siege would have been destroye It was therefore conceded, that it was not desirable to construct line of works between Paris and Versailles.

To select a good position in front of Versailles was not difficult. From Versailles to St. Cyr, about three miles distant, no position fit for occupation is to be found. But on the other side of St. Cyr, in the fork between the railways to Granville and Brest, is a plateau admirably adapted for defence, and on the summit of this plateau the Fort of St. Cyr is being built. It is a very large work, and as it is between three and four miles distant from the fort of Haut-Buc on the left, and still farther from the nearest work on its right, it requires great power of independent resistance. In front of the work is a level plain without a hedge or an undulation, broken only by ditches and a few banks, and here and there by a farm house or a cluster of trees. Immediately before the left face of the fort there is a large lake, the Etang de St. Quentin. To the right the guns of the work will see across the plain towards Les Clayes, and in the direction of the far distant Fort of St. Jamme, but in order to obtain a fire over the valley of the Rû de Gally, that separates St. Cyr from St. Jamme, a smaller work will be constructed near the Bois du Chêne. On the left of the Fort of St. Cyr, the level ground extends for a great distance towards Guyancourt, in front of the forts of Haut-Buc and Villeras.

Thus, the Fort of St. Cyr is, in every respect, most favourably situated. It commands the main roads to Paris, and can hold out a hand to a relieving army coming from the south-west. It commands a wide and open plain, over which an army might debouch from Versailles to attack the lines of a blockading army, and its guns sweep this plain so thoroughly that an investing force would have to construct their lines at a great distance from the work.

It is a very interesting problem to consider at what distance, under such circumstances, besiegers must in future construct their investing lines. We are not, so far as I am aware, in possession of data that would enable us to solve the problem, but in future sieges the assailants will have to decide it. In designing permanent works, however, it can never be wrong to select a position which, being in other respects suitable, gives the widest possible range of fire for the rifled guns of a fort.

Eastward of Fort St. Cyr rises the Bièvre, a rivulet famous in the controversy that has taken place on the line to be selected for permanent occupation on the south of Paris. The stream runs for some miles a little south of east, nearly to Palaiseau, and then, turning to the north, passes between the forts of Bicêtre and Montrouge, and flows into the Seine near the Gare d'Orléans. The stream itself is insignificant, but the valley in which it flows is deep, and its sides are steep and broken with ravines. On either side of the valley are strong positions, easy to hold, and extremely difficult to attack.

The construction of a line of works on the left or northern bank of the Bièvre was strongly advocated. Such works, it was urged, would be far enough from Paris to secure the city from bombardment, and at the same time not too far advanced to receive assistance and reinforcements from the place. The forts would have in front of them a great natural ditch, which would be under the fire of their guns. There

would be sufficient space in rear of the forts for camping grounds for troops outside the city. The line of heights on the right bank was said to be lower than that on the left.

A further examination of the arguments in favour of this line has shown that they are not conclusive. The main defect of the line is, that however good the position on the left bank may be, the position of an assailant on the right bank would be equally good. The hills on the right bank are only a few feet lower than those on the left, so that they are not really commanded, and an enemy could occupy them, and readily render them very strong. If, therefore, the left bank were occupied by the forts a sortie in this quarter would be impracticable. And it is precisely in this direction that a relieving army may be expected to arrive, and that it is desirable for the besieged to be able to make an effort to break through the investing lines and meet them. Moreover, the valley of the Bièvre presents ground more suitable than can be found elsewhere, not only for camping and hutting troops far away from the city and its influences, but also for locating and pasturing flocks and herds for the sustenance of the garrison and inhabitants. Finally, as the projected outer circle railway will pass along the valley of the Bièvre, it is of the utmost importance to include that valley in the defences, and thus be able to use the railway for carrying stores and provisions to the forts. With a railway thus available in their immediate rear, no apprehension need be entertained of difficulty in supplying or reinforcing the forts. These arguments outweighed those that were urged in favour of the occupation of the left bank of the stream.

The position on the right bank is well adapted for the construction of a permanent line of defences. A level open plateau extends from the summit of the hills on the right bank of the Bièvre on the north, to the little stream of the Yvette on the south. At the cross roads at Saclay is a cluster of two or three houses, and scattered at long distances over the wide expanse there are here and there a few farms and solitary buildings. There are no hedges or fences within a distance of nearly 5,000 yards, and no cover for a besieger. The guns of the works will be able to range over the whole distance to the Yvette without any intervening obstacle. An investing force would have to take up in the first instance the line of the Yvette. If the forts had been placed in the north bank of the Bièvre, the investing force could have occupied the south bank. Thus, the placing the forts on the south of the stream, only about a mile in advance of the other line, throws back the investing lines three or four miles. The line St. Cyr-Palaiseau is not longer than the line St. Cyr-Chatillon, so that the length of the line of permanent works is not increased by their being advanced to the southern and more favourable position.

Three works are being constructed on this line—one at Haut-Buc, one at Villeras, and the third at the end of the plateau on the high hill overlooking the village of Palaiseau and the valley of the Yvette. The forts of Haut-Buc and Villeras are to be of the second class. Their earthworks are already rising up to such a height as to be visible far over the plain, which is so flat that the mere height of

the ramparts will give the artillery the power of sweeping the ground thoroughly for miles in advance, and will also give the artillery a command over the guns of the besieger. Under such circumstances preliminary siege operations must be difficult and tedious, requiring a large expenditure of material. And when the fire of the works has been subdued the besieger will have to commence a second and longer operation. Until the artillery of the forts is absolutely silenced, an advance over the open, save by regular siege works, will be impossible. Consequently every foot of progress over the plain would have to be won with the pick and shovel. Meanwhile the garrison could draw upon the reserves behind them to replace their artillery and stores. The troops in the forts, if exhausted, could be relieved by others who had been lying securely and quietly in rear during the opening attack. If provisions do not fail such a struggle may be prolonged indefinitely, and can end only with the exhaustion of one or the other combatant. And in this struggle the besieged will have one very great advantage. All their reserves of guns, ammunition, and of stores, will be close at hand in or round Paris, and the outer circle railway will bring them to the valley of the Bièvre, and set them down within a mile or two of the line of defence. The besiegers, on the other hand, would have to bring all their stores, guns, and ammunition, from a long distance. The railway would not bring them up within some miles of the batteries. During the last siege the railway terminus was four days by road from the siege park, and in a future siege the distance would be materially increased. In a regular siege of the new forts on the south the contest would become a trial of the resources at the disposal of the combatants, and the besieged would have great advantages, in the facilities they would possess for bringing those resources into action, as well as in the positions they would occupy.

The large work that is being constructed at Palaiseau will form the left of this southern, or, as the French usually call it, south-western chain of defences. The fort stands at the end of the plateau, which is here much narrowed, and in its front and to its left steep, almost precipitous slopes descend to the valley of the Yvette. The fort is high above the valley, and has a very wide command, but the slopes are so steep that its guns will not be able to see much of the ground in its immediate front. Two batteries will, therefore, be constructed in advance to see this ground. To the left of Palaiseau the steep slopes of the Yvette valley are continued in a northerly direction, but the stream itself turns again to the eastward, and continues its course across a flat and cultivated country to the Seine above Juvisy. About a mile and a half from Palaiseau there is a small round hill, called Les Buttes Chaumont. A permanent work will be built on this hill, and will strengthen the fort at Palaiseau, since its guns will sweep the valley and slopes of the Yvette to the left-front of that work. In rear of Palaiseau also a battery is intended to be placed at Verrières, to give support to the front line and connect it with the works in its rear.

The Palaiseau position is exceedingly strong. An enemy could no doubt establish batteries on the south of the Yvette, and bombard the

main and auxiliary works from a distance. But any advance across the valley would be attended by great difficulty. It would be almost impracticable either to scale the steep slopes in front of the works in the face of any opposition, or to advance by the regular operations of a siege.

The works we have enumerated from St. Cyr to Palaiseau protect Paris on the south and south-west. The forts are few in number and far apart, but they cover the ground sufficiently, and if they are well armed and garrisoned, and if the intervals be occupied by a moderate force, no enemy will be able to approach Paris in this quarter without first undertaking and carrying through under great disadvantages of ground a regular siege of uncertain duration.

In rear of this chain of defences the Commission have, in their Report, recommended the erection of a fort at Chatillon for the purpose of supporting the front line, and connecting it with the older system of works. It is probable that in making this recommendation the Commission were influenced by moral and political considerations. The inhabitants of Paris have not forgotten the impression produced on them by the Prussian occupation of this hill, which overlooks the city, and they cannot, of course, appreciate the value of the new and untried line of defences, out of sight of and eight miles distant from the place. To see Chatillon secured by a permanent work would inspire confidence among the inhabitants. It is, however, too far from the front line to give any effective support to it, and the line seems hardly to require such support. The work might be of some use in case of an enemy penetrating up the valley between Palaiseau and the Seine; but, except for this purpose, and apart from political and moral considerations, a fort here seems unnecessary.

Eastward of Palaiseau, the country is flat, as far as the Seine, seven miles distant. On the other side of the river, nearly nine miles from Palaiseau, a large fort of the first class has been projected. Across the flat ground it is intended to have no permanent fortifications further east than the Buttes Chaumont. It is argued that if a body of the enemy were to make their way up this valley, they would have in front of them the double line of the old defences. On their right and left would be the new works, which, though the distances are great, would probably be able to prevent the enemy from bringing forward any artillery, but light field guns. Without siege artillery he could attack neither the works in front nor those on his flanks. He could not maintain himself in such a position without great risk, as he would be exposed to counter-attacks from the troops on his right and left. No prudent general would put himself in such a position. If any assailant were so rash, the troops, on either flank, would quickly force him into disastrous retreat.

This reasoning is, no doubt, sound; and so long as an effective field-army of moderate strength was available, a force thrust into this opening could gain little advantage, and might, if repulsed, be annihilated. Such a force would be offering battle in front and on both flanks at the same time, and would be exposed to the risks of such an operation. And it is, no doubt, almost impossible to conceive that under any

circumstances Paris should be without some troops fit to take the field. In 1870, when one French Army was shut up in Metz, and another had been annihilated at Sedan, there was still, in Paris, a considerable number of troops, who could be regarded as available for active operation.

But defeat and retreat, in the face of the enemy, may disorganize drilled troops, so that for a time they may be unfit to act in the open field, and the troops taking refuge behind the fortifications of Paris would be chiefly beaten troops, or reserves and recruits of various degrees of steadiness, men on whom it would be unwise to rely for offensive movements at the commencement of the siege. At the beginning of the siege, moreover, the enemy's spirits would be raised by recent victory, and neither General nor soldiers would be in the temper to hesitate, if they saw an opportunity, of doing an injury to the besieged at the cost of some danger to themselves. Under such circumstances enterprises have been often carried through successfully and with little risk, which would never have been attempted, if both the forces engaged had been in an equally good condition of *morale* and discipline.

It appears possible, then, that at the commencement of a siege, a bold and enterprising enemy might try to make a raid through such a wide space as intervenes between Palaiseau and Villeneuve St. George. The work at the Buttes Chaumont will command a part of the flat ground, and the bend of the Seine to the westward of Juvisy will narrow the space available for his movements; but a column might advance up the valley without going within four miles of any permanent fort. They would be stopped by the old line of detached forts, and they would probably be unable to capture any permanent work. But they might damage the outer circle railway; they might destroy or carry off stores and provisions and cattle, collected for the besieged; they would spread terror among the inhabitants and the garrison at the very time when it would be most desirable to inspire confidence in all who were within the circle of defences. Considering the effect of such an incursion, it would in my judgment be worth while to construct a small fort between the Buttes Chaumont and the Seine. If this fort were constructed, the gap would be closed, and the work at Chatillon would no longer be required for the purpose of repelling an incursion through the opening.

The position of Villeneuve St. George is of the highest importance. The site selected for the fort is on the top of a steep hill, at the foot of which flows the Seine on the eastward, and the Yères on the south and south-east. It is thus the pivot of the south-eastern defences, whether the line of the Yères be adopted, or whether, as is contemplated, a line be taken up towards the Marne at Ormesson. The fort will command three lines of railway and the course of the Seine. It will see well over the valley in its front, and have a good command to the east and west. It will guard the passage of the Seine at this point, where the Prussians crossed when advancing in 1870, to invest Paris on the south. When the fort is built, an army coming from the east to attack the south will have to cross at Corbeil, ten miles, or Melun, twenty miles, higher up the river.

The ground required for the fort at Villeneuve St. George has bee bought, but work has not been commenced. The funds immediatel available for defences were limited, and it was thought better 1 devote the whole of them to strengthening those parts of the circ round Paris where the old defences are weakest. It was at fir proposed to begin the work at Villeneuve St. George, omitting thos at Haut-Buc and Villeras, but these two works were essential for th line from St. Cyr to Palaiseau, and the fort at Villeneuve withou the works proposed to the north-east of it, would be isolated an unsupported. It was therefore decided to postpone the work a Villeneuve in favour of the south-western defences.

The eastern defences of Paris are already strong. The detache forts built according to the project of 1840, are farther from th enceinte than those on the south, and the ground does not offer suc facilities to the besieger as that on the north and south. The wind ings of the Marne in the south-east forbid any direct attack, bu they likewise prevent any attempt at a counter attack on the part o the garrison.

It is, therefore, considered necessary eventually to occupy the le bank of the Marne, on the line from Villeneuve St. George 1 Ormesson and Noisy-le-Grand. Nothing has been decided, wit respect to the work or works south of Ormesson. North of Ormesso a fort has been projected near Villiers and Noisy, which would cove the four bridges over the Seine at Brie, Nogent, Joinville, and Cham pigny, and give the besieged free access to the left bank of the strean but nothing is yet being done towards the construction of this bridg head of the Marne.

North of the Marne, the existing defences of Paris on the eas consist of a line of works on the edge of the plateau of Montreui The principal forts are Romainville, Noisy, Rosny, and Nogen There are also some redoubts and entrenchments. The position : strong and good, and the works are sufficiently far from Paris t secure the city from bombardment. The necessity for addition defences here is not, therefore, so pressing as in the north and soutl It is, however, desirable to deprive the enemy in a future siege, of th power of occupying the strong positions in the Forêt de Bondy, whe the Prussians placed their batteries in 1870–71, and the occupation o which rendered sorties at this part of the line impracticable.

It has been determined, therefore, to occupy the summit of th ridge that runs east and west, parallel to the Canal de l'Ourcq, by fort above Vaujours. This work will command the great nort eastern plain to its left in front of Bondy, which is at the end of th inundation previously mentioned, and will thus connect the norther with the eastern defences. Its guns will see along the ridge in fron and will command the flat ground south of that ridge for some mile A range of hills runs at right angles to the Vaujours ridge b Montfermeil. A work of the second order is to be placed on a roun hill at the south of this range, near Chelles. This fort will com mand the Marne on its right, and the level ground towards Lagny i its front. The position Chelles-Vaujours is exceedingly strong. Th

ridge in front of the principal work is seamed with ravines and thickly wooded, but the ground in front of the rest of the position is open and level, and well seen from the sites selected for the works.

It remains only to describe the defences projected for the west of Paris. Westward from Marly runs a range of hills culminating at Ste. Jamme and Aigremont. The summit of the hills here is perfectly flat, and of that peculiarly open character common in France, but never seen in this country. The slopes, both on the north and on the south of the plateau, are so steep as to be almost inaccessible, except by the winding roads, which connect the villages. A fort of the second class at Aigremont will command the wide valley and the windings of the Seine on the right of the position, which are overlooked from the northward by the work being constructed at Cormeil. A fort of the first class at St. Jamme will command the valley of the Rû de Gally and form a connection, though at a great distance, with the St. Cyr defences. Though the distance from St. Jamme to the Bois du Chêne is about five miles, the valley between them is little more than half that distance across, and is so thoroughly commanded by the heights behind St. Jamme, that no force could descend it without first obtaining possession of those heights.

It has been suggested that the heights of Hautie on the right bank of the Seine should be occupied, but the work projected there is not included in the project finally approved.

It was at first proposed, instead of occupying the St. Jamme plateau, to place a work at the Trou d'Enfer near Marly. But the Forêt de Marly would then have been abandoned to the enemy, and would have been a position of great strength for a blockading force. The idea of occupying the Trou d'Enfer does not, however, appear as yet to have been altogether abandoned, as it is thought an intermediate work on this site may be advantageous to connect the very advanced works at St. Jamme with the fortress of Mont Valérien.

Considering that the position of Marly could be easily strengthened with field works, and that Mont Valérien already renders Paris secure both from attack and bombardment on the west, it has been determined to postpone the construction of these defences on the west, until more pressing needs elsewhere are supplied.

The general design for the new defences round Paris is undoubtedly bold and masterly. The projectors have discarded the theory that detached forts must be within sight and easy range of the enceinte, a theory abandoned long since in this country, but which continental engineers have been unwilling to relinquish. The long range of rifled artillery admits of great latitude in the choice of positions, and the French engineers have availed themselves of this advantage, and of the facilities afforded by the ground, to cover a great extent of country with well-placed works very few in number, having regard to the length of the line occupied. These works, however, form merely the skeleton of the system of defences necessary to defend Paris. Redoubts, batteries, and entrenchments must be thrown up at a time of expected attack in the intervals between the works. The presence

of the permanent works will make it easy to add these auxiliary defences. If, however, the permanent works were not to be built, the attempt to construct field works on the advanced positions at a time of expected attack would either never be made, or would probably be soon abandoned. Field works were very necessary, and were attempted to be thrown up by the French on the south of Paris before the last siege. But when the Germans arrived the works were still unfinished, and were at once given up.

The design of the forts under construction is radically different from that of the old works of the scheme of 1840. The bastioned trace is no longer seen in the faces of the works, and the ditches will be flanked by caponiers. The earthworks for the ramparts are being thrown up without waiting for the completion of the casemates, and are expected, according to the report of the Commission, to be so far advanced by the end of the first year as to form "good redoubts." In other words, the works on the north and south are intended to be made during the present year capable of offering resistance. The casemates, magazines, and caponiers, commenced at the same time as the earthwork, are to be finished next year. The escarps and counterscarps, the formation of the ramparts, and the other preparations necessary for the reception of the permanent armament, are to be completed in the third year after commencement.

It is thought that a fort should be manned and organised like a ship, and all the crew off duty should be below, and bomb-proof accommodation is therefore being provided for nearly the whole of the garrison. The garrisons are estimated at from 1,200 to 1,500 men for each fort. The number required for the garrisons of the whole of the advanced forts, calculated on this basis, would be less than 30,000 men. These must all, however, be good troops, for a panic in the garrison of one of the advanced works at a critical moment might have very serious results.

It is considered, that under any conceivable circumstances, there would be in Paris, in addition to these garrisons, 50,000 regular troops, who would be available for guarding the intervals between the forts, and manœuvring at the points most threatened by the enemy. The enceinte and the whole line of detached forts would be entrusted to the reserve of the territorial Army, men between 34 and 40 years of age. The territorial Army could also furnish 100,000 men fit to be associated with the regulars in guarding the outside of the circle and in active operations. Such a force would suffice to defend the place, and to make the sorties which are necessary for a good defence.

The cost of the whole project is estimated at 60 million francs or £2,400,000, of which £2,048,000 are required for works, and the rest for land and contingencies. For the tête-de-pont of the Marne, a round sum of £440,000 is put down. From the amounts allotted to the other works, some idea may be formed of their comparative size and importance. The smallest forts are to cost £60,000 each. The works of the second class, such as Haut-Buc, Villeras, Montlignon, and others, are each to cost £80,000.

Domont, St. Jamme, and Villeneuve St. George, are estimated to cost £120,000. The estimates for the great fortresses of Palaiseau and St. Cyr with their outworks rise to the large totals of £160,000 and £168,000 respectively. The project, as a whole, has been approved by the National Assembly, and a sum of £280,000 was appropriated in 1874 to commence the more important works, and acquire the sites for the whole of the proposed defences on the north and on the south.

I will briefly recapitulate the principal points that are to be occupied by works. On the north, a large work at Montlignon, and a small one at Domont, will occupy the centre of the position. A work on the ridge at Cormeil guards the left of the line, and overlooks the valley of the Lower Seine. Ecouen, Montmorency, and Stains guard the right, and command the plain of the north-east, and the inundation extending to the Canal de l'Ourcq near Bondy. Cormeil, Domont, and Stains are in progress, and the other works will be begun shortly.

On the south-west and south, the ground between the Rû de Gally and the Seine will be occupied by five works. The large fort of St. Cyr is in front of Versailles, and forms the right of the line, with a battery to fire across the Rû de Gally. Left of St. Cyr, the plateau of Saclay south of the Bièvre is occupied by two works of the second class at Haut-Buc and Villeras. The line is terminated by a large work at Palaiseau at the eastern end of the plateau, where the ground falls abruptly to the Yvette. In front of Palaiseau, two batteries will command the ground hidden from the fort by the steepness of the slopes. A work of the second class on the Buttes Chaumont will flank the end of the line, and command a portion of the space between Palaiseau and the Seine. All these works, except at the Buttes Chaumont, are in progress, and the earthwork of the ramparts well advanced towards completion. Behind Palaiseau, a battery will probably be placed at Verrières. A work has been projected at Chatillon.

The eastern defences are in two sections. The southern section will comprise the important work of Villeneuve St. George guarding the passage of the Seine, and the tête-de-pont of the Marne. The land has been bought for Villeneuve St. George, but the details of the tête-de-pont are not yet finally determined upon.

North of the Marne a fort of the second class is to be made at Chelles, to command the level ground in front and the course of the Marne, and a large work is to be built on the summit of the ridge near Vaujours, whence there is a good view over the plain of the north-east. On the west, two works, a large one at St. Jamme and a small one at Aigremont, will occupy the hills, flat on the top but almost precipitous at the sides, which divide the valley of the Lower Seine from the valley of the Rû de Gally. A work near Marly has been proposed and discussed. The defences of the east and west are not yet commenced.

The defences of the North and South will, however, suffice to give most of the advantages desired. Paris will be secure from bombard-

ment when they are completed, and in two directions the ground will be favourable for making sorties.

When the whole of the defences are completed, the perimeter of the area enclosed, measured from the salients of the works, will be about 77 miles, or more than twice the perimeter of the ground enclosed by the detached forts of the project of 1840. The length of the line of investment of a besieger of these works would be between 90 and 100 miles.

But the extension of the length of the line is only one of the advantages gained by these defences. The garrison will on every side hold possession of the salient and most commanding positions; enclosing a fertile belt of country, where provisions both live and dead may be accumulated, where troops can be camped and drilled and moved out of sight of the besieger, and away from the distractions of the capital. The inhabitants and the troops off duty may rest in perfect security, while the outer line is being cannonaded, instead of living night and day in a state of unceasing dread, as they did during the former siege. It will, under these circumstances, be far easier both to keep the inhabitants quiet, and to organize and drill the troops.

Paris will be stronger than it ever was before, more difficult to invest, more capable of making a prolonged resistance. Larger forces will be required, and greater risks will be encountered by the blockading force. The ground they will have to occupy will be more difficult to hold, the distances to be traversed in collecting troops on a threatened point will be longer. The besieged will be able to make more effective attempts to break through the line than heretofore, and will probably be better provisioned. Under these circumstances could an effective blockade be maintained long enough to reduce the garrison to surrender for want of food?

If the blockade could be maintained, the place might hold out for a very long time, but must succumb at last. To maintain an effective blockade, however, would require much larger forces than the Germans had in 1870. If a blockade could not be maintained the invader might either undertake a partial siege, attacking one side and leaving the other side open; or he might abandon the siege, overrun and devastate France, and endeavour to reduce the country to such a state of exhaustion as to compel the nation to submit.

In either case the invader would have before him a most difficult task. The siege of Sebastopol showed how tedious is the siege of a great fortress well supplied, and with the power of replenishing its stores and food, and reinforcing its garrison. The siege of Paris in 1870–71 showed how great is the power of resistance, and what are the resources contained within the place itself. If those resources were supplemented by fresh supplies from outside, if non-combatants could be sent out of the place into parts of the country unoccupied by the enemy, if, moreover, the army in Paris had, as they will have when the new works are finished, fair and open ground in several parts of the circle of defences for making vigorous counter-attacks, the siege could

only be brought to an end by the complete exhaustion of one of the combatants.

And the invader, far from his base of supplies, would have at the same time to push forward the immense siege works necessary for the capture of the place, to bring up from a distance supplies of siege artillery, ammunition, and stores. He would have to maintain and feed the force necessary for the attack of the place, and also the force required for preventing the formation of, or opposing when formed, the armies that would be raised in other parts of France. All this he would have to do for many months, perhaps, nay probably, for years, for Paris, strengthened by the new works and abundantly provisioned, would hardly be captured in a period to be measured by months. Before such an undertaking as this the most wealthy and powerful invader must pause.

Or, on the other hand, the invader might decide to leave only an army of observation before Paris, and to employ the bulk of his forces in endeavouring to subdue the rest of the country, and to appropriate to himself or exhaust the supplies it contained. But how great and prolonged an effort and how vast would be the forces required to subdue and hold the whole extent of the country from Belgium to the Pyrenees, from the Rhine to the Atlantic, in the face even of such a resistance as was made in 1871! And when this task was accomplished, if it ever could be accomplished, would Paris capitulate? Is it likely that, with Paris and all its resources still untouched, the nation would not have both the spirit and the power to hold out? If they did hold out, the invader would have to commence the siege of the place. The besieged would be able to draw fewer supplies than before from the exhausted country; but meanwhile they would have laid in such stocks of provisions, and have so drilled and trained the garrison, that the siege would be more difficult than ever.

If, then, the investment of Paris be rendered impracticable, the operations necessary for reducing the nation to such a prostrate condition as to sue for peace would be of such a character, that the invader must, after success in the field, be compelled to pause and reconsider his position. Before him would appear a vista of interminable warfare, and the victory looming dimly in the distance would only be obtainable at the price of the exhaustion of his own nation by years of unceasing efforts.

In such a posture of affairs it might happen that, as Torres Vedras stopped Massena in 1810,—as the Quadrilateral stopped Louis Napoleon in 1859,—the Fortifications of Paris might save France.

PRIZE ESSAY, 1875.

UNIVERSAL CONSCRIPTION: THE ONLY ANSWER TO THE RECRUITING QUESTION.

"On trouve encore des officiers vraiment volontaires, mais plus ou trop peu de soldats."—COMTE, "PHILOSOPHIE POSITIVE," vi. 354.

By Captain H. W. L. HIME, R.A., F.S.S.

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Introduction.

THE following Essay is divided into three Parts.

The first Part is an historical sketch of the English System of Voluntary Enlistment, from which I draw this conclusion; that the system never was a success, that it is breaking down at the present time, and that it will, in all human probability, collapse altogether before very long.

The second Part is an inquiry into the respective merits of the four possible systems of Recruiting, from which I draw this conclusion; that the Compulsory is the only system that will satisfy the exigencies of our case, as far as the Home Army is concerned.

In the third Part I propose, for the Home Army, a scheme of Universal Conscription, without substitution or dotation.

PART I.—ON VOLUNTARY RECRUITING.

Instead of building vain theories upon empty arguments, let us trace the working of the voluntary system of recruiting in England by means of facts and figures.

I. From 1715 to 1867 it was found necessary, from time to time, to offer a bounty, in order to induce men to enroll themselves in our voluntary Army. In 1745, the bounty for the Guards was £6. In 1759, the bounty offered by Government having proved insufficient, "several large towns opened subscriptions to be appropriated as bounty "money to volunteers enlisting in the Army. The London subscription "amounted to £7,039, procuring 1,235 men at £5 5*s*. each."[1] This was no isolated occurrence; for in 1716, "large contributions had been "made by different counties and towns, for the purpose of assisting "Government in the raising of recruits."[2]

These curious facts prove the truth and justness of Professor Cairnes' remarks upon a speech delivered by the Earl of Derby at Liverpool, 1871. Alluding to Conscription, Lord Derby said that public feeling revolts against the practice, "in a country where the sentiment of "individual freedom and conscience is as highly developed as here."

"The times are serious," replies the Professor; "let us purge our souls of cant. What does this system of 'voluntary' recruiting, which we are asked to believe is the only system suited to our highly-developed political and moral feelings, mean? Simply this, that people who have sufficient means, instead of being required to pay their just debt to their country in their own persons, are allowed to hire others, who have little choice but to accept this offer, to expose their persons in their behalf. No less lofty principle than this, it seems, can satisfy the highly-developed consciences

[1] Clode's "Military Forces of the Crown," ii. 5.

[2] Dr. Marshall's "Military Miscellany," 1846, p. 48.

of the English people. The moral fastidiousness displayed is only surpassed in China, where, it is said, men may procure substitutes for the gallows. The principle would, indeed, need to be high; for it is certainly not redeemed by the practice—by what is known as 'our pot-house system of recruiting,' in which men are entrapped, to borrow the words of the late Sidney Herbert, 'by every kind of cajolery and inducement we can devise, and in our necessity we descend to those means which men do not have recourse to till they think all others are exhausted.' Well, all this may be highly convenient: but, in the name of common decency, let us cease to put it forward as a national distinction to be proud of—a practice entitling the people who employ it to look down, as from a lofty height, on the nations who expect each capable citizen to bear his share in his own and his country's defence."[1]

In 1775, the bounty was £3, and militia volunteers for the Line received £6 in 1802.[2] The bounty for the ordinary recruit in 1803 was £16.[3] In 1855, the bounty was £8 for the Infantry, £9 for the Marines,[4] and £10 for the Artillery.

Bounties continued to be given, at varying rates, until 1867, when they were abolished: but I have no hesitation in saying that, with our present system of recruiting, it would be necessary to revive them, if we became involved in a great war.

II. "In 1614," says Adam Smith, "the pay of a foot soldier was the " same as in the present times (1776), eightpence a day. When it was " first established it would naturally be regulated by the usual wages of " common labourers, the rank of people from which foot soldiers are " commonly drawn."[5] The experience of the century which has elapsed since Smith wrote amply proves the truth of the principle implied in the foregoing sentence. The wages of labour and the pay of our volunteer soldiers have been surely, although slowly, increasing during the last hundred years. In 1797, the pay of an Infantry soldier on home service was one shilling a day, with stoppages of 6¾*d.* a day for rations.[6] In 1874, his pay is one shilling a day, with free rations of bread and meat. This may seem a trifling increase, considering the time that has elapsed; but we must not confound a soldier's *pay* with his *income*. His pay has somewhat increased, his income has enormously increased since 1797; because it has always been the policy of Government to improve his condition, "rather by waiving deductions and adding other consequent advantages, as better clothing, barrack, and hospital accommodation," than by increasing his actual pay.

III. An additional inducement was held out to recruits, not many years ago, in the shape of good conduct pay. I may remark that the good conduct required is of a singularly negative character. To become entitled to good conduct pay, a soldier has neither to distinguish himself as a soldier, nor as a man. It is unnecessary for him to become noted for expertness at drill, or for the general smartness and cleanliness of his personal appearance. He has to raise himself to no standard, however low, of physical, moral, or intellectual worth. All he has to do to gain his badge is to abstain, for a certain period, from positive military evil, or to sin so discreetly as to avoid detection.

In 1870, the good conduct pay of the Army amounted to £218,463,

[1] "A National or a Standing Army?" in "Political Essays," by J. E. Cairnes, Emeritus Professor of Political Economy, University College, London, p. 232–3.
[2] Clode, i. 287 [3] Ibid., ii. 53. [4] Ibid., i. 308, note.
[5] "Wealth of Nations," i. 81; Rogers' ed. [6] Clode, i. 106.

and in 1873 to £246,852. The increase in the amount is easily accounted for. In June, 1870, appeared a new Warrant, the regulations of which rendered it easier to gain a badge than before. The natural result was, that a greater number of men gained badges.

In addition to good conduct pay, a certain number of good conduct medals, with or without gratuities, are annually distributed among those who have been in receipt of good conduct pay for a certain time. Taking the medals to be worth 5*s.* each, and the gratuities to average £7 each, the value of these prizes amounted in 1873 to £9,698, exclusive of eight medals with annuities.[1] Whether these sums were paid out of the ample funds supplied by the fines for drunkenness, I know not.

IV. In 1697, there was only barrack accommodation in England for 5,000 men, and an estimate was laid before Parliament in that year for tents, &c., for 6,000 Infantry and 4,000 Cavalry. The misery endured by the unfortunate troops who were thus exposed, all the long year, to the vicissitudes of an English climate was great; but it was not great enough to overcome the popular prejudice against barracks, and this state of things continued, more or less, to exist until 1792, when the barrack department was formed and barracks were commenced on a large scale. In 1707, two regiments who had been long encamped in the Isle of Wight suffered so severely during the month of October that orders were given to hire "either *barns or empty houses*, "whereby the soldiers may be *kept from perishing* through the *severity of* "*the weather*." Where barracks did exist, they were of the worst construction. During the year 1704, Lord Paston's regiment, which was quartered at Portsmouth, was reduced by death and desertion to one half of its numbers, "from the sickness of the place, the want of firing, "and the badness of the barracks." In 1718, £9,300 was voted to build barracks in various towns in Scotland for the accommodation of 800 men in all, the rooms of which, 18 feet by 17 feet square, were to contain five men each.

"By way of contrast to the expenditure of 1718," says Mr. Clode, "take that of 1859-60 on the new palatial residence of the Guards at Chelsea, built at a cost (including ground, but excluding furniture) of £296,831: the first sum is under £12 a man, and the second not under £225 a man."[2]

V. About a century ago,

"an unhappy governor wrote that he had under his command a company of troops which for fifteen years had received no fresh bedding: and 'many of the soldiers were very ill, and in yᵉ winter ready to starve.' A special messenger was sent home to lay the matter before the Board of Ordnance; but the Board adroitly pigeon-holed his petition for four years, and in the language of a subsequent letter, 'for want of bedding, many of yᵉ soldiers have since perished.'"[3]

The bedding and clothing of the troops is now incomparably better than that of the classes from which they come; and large sums are annually spent on these items, to induce men to remain in the ranks. In 1872-73, the estimate for clothing was £751,700, and £743,100 in 1873-74.

[1] "General Annual Returns of the British Army for 1872." War Office, 1874. Tables 35, 36, and 37.

[2] The above facts are taken from Mr. Clode's "Military Forces of the Crown," chap. xi.

[3] Duncan's "History of the Royal Artillery," i. 21.

VI. The like remarks apply to the food of the soldier. Improvements might be made in his breakfast and tea, but his dinner is very much better than that of the lower classes. In 1872-73, £1,784,300 was voted for provisions, &c., and £1,980,700 in 1873-74.

VII. Vast sums have been spent in providing the troops with suitable hospital accommodation and medical attendance, and it cannot be doubted but that they are in this respect infinitely better off as soldiers than they would be as civilians. £334,172 was spent on the hospital at Netley, and £228,355 on the Herbert Hospital at Woolwich, the one being at £294, and the other at £344 per man.[1] The pay of the Medical Establishment is nearly a quarter of a million per annum.

VIII. As early as 1697,[2] the prospect of a pension had necessarily to be held out to men enlisting for life or long service. The annual expenditure on pensions increased gradually from £181,402 in 1806 to £1,291,200 in 1872. (See Table A in the Appendix.[3])

Having described the inducements held out from time to time to men to enrol themselves in our voluntary Army, I shall now endeavour to show the effect produced by these inducements in getting recruits for life service, long service, and short service.

IX. From a very early period the ordinary system of raising recruits in England was called the contract system. A certain sum of money, according to this system, was annually allowed to the Colonel of a regiment on condition that he kept the regiment up to a certain strength, and he was allowed to enlist men on what terms he could. It is needless to say that "so long as this mode of providing recruits was "in force, the officers had a pecuniary interest in continuing the system "of life enlistments."[4] This system succeeded in supplying England with the handful of men she required for her standing army in time of peace; but it was inapplicable in time of war, for two important reasons. In the first place, "it was the national policy that the army should be disbanded after each war, and therefore, had Parliament adopted long enlistments, an excuse would have been given to the Crown for keeping the army on foot while those enlistments were in force."[5] In the second place, "the absence of any barrack accommodation, sufficient for a large army, rendered it a matter of necessity to disband the troops on the war establishment upon their return into the kingdom."[6] Now the want of barrack accommodation was due, as Mr. Clode admits,[7] to the well-grounded apprehension that an increase of the number of barracks would infallibly lead to an increase of the strength of the standing army. The adoption of short service enlistment, therefore, on the breaking out of war, in order to raise the peace establishment to a war establishment, was due in no way to any acknowledged superiority of short service over long or life service, but entirely to political causes. Prior to the present century, then, although ordinary enlistments still continued to be made for life, short service always prevailed in the army whenever Parliament raised it from a peace to a

[1] Clode, ii. 464. [2] Clode, ii. 275.
[3] Ibid., ii. 281, 781; and "Statesman's Year Book," 1874.
[4] Clode, ii. 24.
[5] Clode, ii. 25. [6] Ibid. [7] Ibid., i. 257.

war establishment and provided the recruits by coercive measures (a special vote of levy money.[1]

In 1775 the American War of Independence broke out, and or 8th November of that year the Minister at War stated, in the Hou Commons—

"that all his exertions had failed in recruiting the Army to its requisite stre He said no means had been untried to complete the corps to the full complem the bounty had been raised, the standard lowered, and attempts had been ma *enlist even Roman Catholics*, and to incorporate foreigners singly into the B regiments, but all had failed in the expected effect."[2]

In 1796 Mr. Pitt carried a Bill for five years' service in Eu only. The restriction of the area of service was, no doubt, inter to be a safeguard against the difficulties which led to the repea Queen Anne's three years' Act, and to the Mutiny of the 68th and Regiments at Portsmouth in 1783. "It was soon found to be im "sible," says Mr. Clode, "to carry out the regular routine service the Army with the three years' service men enlisted under 7 Anne, "for they demanded their discharge rather than go into bad quar "or unhealthy climates. The clause, therefore, was omitted from "Mutiny Act after 13 Anne, c. 44, and the regiments on the P "Establishment were recruited upon the ordinary conditions of "enlistment."[3] In ignorance, or in defiance of these facts, howe the 68th and 77th Regiments were largely recruited, some eighty y after, with men engaged to serve for three years, or until the end the American war. In 1783 both these regiments refused to emb for India, "alleging as a reason for their insubordination, that "were enlisted on the express condition to serve three years only "during the American war."[4] Mr. Pitt's Bill avoided to a great ex these difficulties, but it was open to the other objections which h always proved, and must always prove fatal to Short Enlistment for Armies on the Voluntary System. Under the operation of Act matters grew worse and worse until the year 1806, when a recr ing crisis, resembling that of 1775, occurred. "Throughout the wh "war great difficulty had been experienced in providing a proper sup "of soldiers;"[5] "the hulks were drained, and the prisons emptied m "than once to supply the want of recruits;"[6] the Bounty rose in 1 to £16 16*s*.: but all these measures failed; the effectives were 25, men below the establishment in 1806;[7] and in that year Parliam was again called upon to decide "how we are to ensure to this coun "what unquestionably it has never had, a never-failing and adequ "supply of regular soldiers."[8]

As a solution of the difficulty, Parliament accepted Mr. Wyndha Bill for limited enlistment, which divided the total service into th periods, as shown in Table B in the Appendix.

A man could claim his discharge at the end of the first period with

[1] Clode, ii. 25. [2] "Military Miscellany," p. 48. [3] Clode, ii. 25

[4] "Military Miscellany," p. 58.

[5] Alison's "History of Europe," vi. 105.

[6] Dupin's "Military Force of Great Britain."

[7] Alison's "History of Europe," vi. 112, note.

[8] Wyndham's Speech in the House of Commons, 1806, in Alison vol. 107, note

pension. He might claim his discharge at the end of the second period with a pension of five pence a-day for life. At the end of the third period he was discharged with a pension of one shilling a-day for life. If he claimed his discharge before the expiration of the third period, he was liable to be called upon to serve in an emergency; but after the third period he was free. This Bill continued in force only two years, in consequence of Lord Castlereagh carrying a clause, in 1808, to permit men to enlist for life, "by which means Mr. Wynd-" ham's scheme of recruiting was practically annulled."[1]

The reasons for this change are palpable. In the first place, as Mr. Clode observes,

"the whole tendency of the measure was towards *long* service, but obtained at a higher rate of pay and pension than had before been granted by Parliament for the same service. * * * The total cost, in a year or two after it came into full operation, has been variously estimated as ranging between £1,300,000 and £1,500,000 per annum."[2]

In the second place, a small increase in the Bounty secured men for life service, at far less cost.

"Before Wyndham's Bill was introduced, Lord Castlereagh assured the House of Commons that the difference between twelve guineas for unlimited, and ten guineas for limited, service, had induced all but 250 out of 9,000 men to enlist for the former service; and at a later date it is undoubtedly true that the difference of only 16*s*. given in 1819, induced recruits to select unlimited service."[3]

Recruits had the option of enlisting for limited or unlimited service from 1808 until 1829, when limited engagements were wholly discontinued.[4] A glance at Table C in the Appendix[5] will show the superiority of life over limited service, in the popular estimation.

In 1847, with excellent reason, unlimited service was abolished, and the period of service for the Infantry was fixed at ten years, with permission to re-engage for eleven years. During the Crimean war, this Bill had to be relaxed, and the Crown was authorised to enlist men for short service. Had the extra men required during the war been enlisted for long service, they would have proved an unnecessary burden to the country on peace being made. Short service, even with high bounties, was cheaper; and short service, consequently, was adopted.

In 1867, the period of service was fixed at twelve years, with power to re-engage on completion of two-thirds of the original engagement. "The number of re-engaged men on the 30th June, 1867, was 31,205, " and from that date to the 31st December, 1868, a further number of " 40,988 men re-engaged under the Act of 1867—making a total of " 72,193 long service men working for future pension."[6]

Finally, in 1870, was passed an Act, which "aimed at 1st, improv-" ing the social position of the soldier; 2ndly, mobilising the Active " and Reserve forces; 3rdly, popularising the Army; and 4thly, " forming an efficient Reserve."[7] These were splendid aims indeed; and what were the means adopted to gain them? A Short Service Act,

[1] "Military Miscellany," p. 71.
[2] Clode, ii. 286, 288.
[3] Clode, ii. 28.
[4] Ibid., ii. 30.
[5] "Military Miscellany," pp. 74, 75.
[6] Clode, ii. 31-2.
[7] Dr. Leith Adams, F.R.S., *vide* his lecture in the R. U. S. I. *Journal*, vol. xviii. No. 76, p. 67.

without bounty! Mrs. Partington's exploit was nothing to this. That excellent woman, as Sidney Smith tells us, lived by the sea. One morning an unusually high tide invaded her cottage, and when the neighbours came to her assistance, they found her sweeping out the sea with a besom. Her well-intended efforts, however, were futile. She was equal to a bowl or a puddle, but she was no match for the Atlantic Ocean! Acts of Parliament and War Office circulars have a certain power, but they cannot stem the tide of popular opinion. The Act of 1870 has not improved the social position of the soldier; it cannot be said to have popularised the Army; and it certainly has not formed an efficient Reserve. Although assisted by the operation of certain causes, never dreamt of by its framers, the Act of 1870, far from being able to stand the strain of war, is confessedly incapable of satisfying, single-handed, the demands of our Peace Establishment. Long service has not yet been abolished; the Short Service Act itself had to be considerably modified very shortly after it came into operation; and a man can now (I believe) enlist for three, six, twelve, or twenty-one years. In plain language, short service and long service recruiting are going on side by side. The expedient is not a new one.

The foregoing sketch of the length of service at different periods shows that short service, long service, and life service have been repeatedly tried by bewildered Ministers, from the Revolution down to the present time, not only simply and singly, but in every possible form and combination that human ingenuity could suggest, and that every successive effort to stimulate voluntary enlistment has, sooner or later, ended in failure. Let us enquire into the causes which led to such results.

X. The general disinclination of the industrial population of this country to military service is sufficiently proved by the magnitude of the inducements found necessary to prevail upon men to enlist, and the large amount of desertion that has always existed in our Army. This disinclination being granted, it is evident that had the inducements offered to men to enlist for short, long, and life service been equal, the recruits, one and all, would have selected short service. History proves, however, that while there has never been a sufficient and continuous supply of recruits for short service, there has rarely been a scarcity of recruits for long and life service. This result must consequently have been due to some difference in the inducements in either case. Did any such difference ever exist? Always. While the prospect of a pension has always been necessarily held out to men enlisting for long and life service, it has been always as necessarily withheld from recruits for short service. To this cause, and to this cause alone, has been due the eventual collapse of every Short Service Act, from the want of recruits.

"But," replies Mr. Holms, M.P., "there is an abundance of incontestible proofs * * * that a pension after a long period of military life has ceased to prove a sufficient inducement. Among them is a statement just made by the Inspector-General of Military Prisons. According to his report for the year 1878, the increase of desertions among old soldiers—that is to say, among men who have served fifteen years and upwards—is very marked; the proportion being 3·6 per cent. for that year, compared with 2·2 for the year before."[1]

[1] *The Times*, 4th November, 187

What Mr. Holms' other incontestible proofs are, I do not know; but this proof is far from being incontestible. In 1872, 5,861 men deserted from the Army; 5,702 deserted in 1873. Of these, 2,034 were imprisoned in the military prisons in 1872, and 1,793 in 1873. The deserters of fifteen years' service and upwards, imprisoned in military prisons, numbered 36 out of 2,034, or 1·7 per cent. in 1872, and 32 out of 1793, or 1·7 per cent. in 1873.

Mr. Holms' figures are not those of the Inspector-General of Military Prisons: they are those of the Revd. Mr. de Renzi, Chaplain of Millbank.[1] They relate only to the prisoners in one prison for two years, and their value was always so doubtful, that even Mr. de Renzi himself admitted they might be "purely accidental."[2] The first principle of statistical investigation is, that we should deal with large figures extending over a considerable time; and when this principle is wantonly violated, as it has been in this case, figures may, indeed, be made to prove anything.

The supply of recruits has almost always been deficient for short service; it has been generally sufficient for long and life service; and, I repeat, the only assignable reason for the difference in either case, is the difference in the inducements, or, in other words, the pension.

In the early stages of society every man is a warrior, and wars are waged, on no principles of right or justice, but simply from a combined love of bloodshed and plunder. As civilisation progresses, however, the military spirit gradually gives way to the industrial; the military class is absorbed more and more by the commercial; and arms become, at length, a distinct and separate profession. When this stage of civilisation is reached, men adopt the profession of arms on the same prudential grounds that they adopt any other profession or calling.

> "Ille gravem duro terram qui vertit aratro,
> Perfidus hic caupo, miles nautæque, per omne
> Audaces mare qui currunt, hâc mente laborem
> Sese ferre, senes ut in otia tuta recedant,
> Aiunt, quum sibi sint congesta cibaria. . . . ."[3]

The hard-handed ploughman sweats behind his plough, the thievish publican toils in his bar, the soldier and the sailor brave the dangers of the land and the sea—and why? To accumulate the little treasure that will enable them to pass the evening of their lives in peace and repose.

Long service enlistments necessarily involve a pension that places its recipient beyond the dread of starvation. Short service as necessarily excludes all hope of pension. It fritters away some of the best years of human existence, and then throws a man back upon the world to recommence his life. No one has described more admirably than Goldsmith this inevitable tendency of every Short Service Act.

"Not far from this city," he says, "lives a poor tinker, who has educated seven sons, all at this very time in arms, and fighting for their country; and what reward, do you think, has the tinker from the State for such important services? None in the world; his sons, when the war is over, may probably be whipt from parish to

[1] "Report of the Inspector-General of Military Prisons," 1873, p. 21.
[2] Ibid.
[3] Horace, Sat. I. 1, 28.

parish as vagabonds, and the old man, when past labour, may die a prisoner in some House of Correction."[1]

It is easy to understand, then, the unwillingness of men to enlist under a Short Service Act; it is easy to understand their unwillingness to remain under the flag when they have enlisted; and desertion, be it remembered, is a far more formidable evil in a short service than in a long service army, because, as the Royal Commissioners of 1859 pointed out, desertion is "mainly confined . . . . to the earliest periods of the soldiers' service."[2] Table D in the Appendix proves the correctness of this statement.[3] From that table it appears that of the 33,419 men who deserted during the first twenty years of their service from 1859 to 1865, 27,306, or ·817 of the total number, deserted at five years' service and under,—a fact which enables us to compare the relative amount of desertion in long and short service armies. Let us suppose that two armies of equal strength are raised, the one for long service of twenty years, the other for short service of five years; and that the percentage of desertion, during each year of service, corresponds in both with the average of the seven years, 1859—65. Then, if the total amount of desertion in the long service army for twenty years be x, the total amount of desertion in the short service army, or series of four armies, will evidently be four times ·817, or 3·268 x. Thus, if the long service army loses 10,000 men by desertion in twenty years, the short service army would lose 32,680 men. This calculation only applies to the men originally enlisted in either army; but the recruits enlisted to fill the vacancies would desert in a similar proportion.

On the whole, then, we may safely conclude that nothing short of a radical change in the constitution of human nature will ensure a sufficient and continuous supply of recruits from a Short Service Act in a civilised community, with a voluntary system of enlistment.

The foregoing remarks on short service apply only partially to the Act of 1870; for unlike all previous short service Acts, it is a Short Service Act with a temporary pension.

For a short time service in the Reserve was naturally taken by the classes among whom we enlist to mean something, and 4*d.* a day was not considered sufficient compensation for the sacrifices such service might entail. Ere long, however, it was discovered that service in the Reserve meant simply nothing, and that the only obligation imposed upon the reserve soldier was to draw his pay. Practically, therefore, the Act became a Short Service Act with a pension of 4*d.* a day for a certain number of years. If, in addition to this, we take into consideration the number of surplus hands thrown upon the labour market by the check in emigration during the last two years, and by the increasing application of the steam engine to agricultural purposes, we can readily understand why the Short Service Act of 1870 enjoys a brief popularity as a means of escaping from temporary want.[4] The Act of 1870, then, being a Short Service Act with a temporary pension, is proof to a certain extent against the objections which bear

[1] "Citizen of the World," No. LXXI.
[2] Report, p. xii. [3] Recruiting Commission, 1867, p. 252.
[4] "Report of the Inspector-General of Military Prisons," 1873, pp. 11, 16.

against all other Short Service Acts, with the exception of the frequency of desertion; but it is nevertheless open to the insuperable objections I shall presently mention, to which all possible systems of voluntary enlistment are exposed.

XI. Unlimited or life service is equally objectionable from a political and medical point of view. The political objections will be found in Burke's short but exhaustive speech on the subject, delivered in 1783. The medical objections are summed up in Table E, which has been compiled from the "Army Medical Blue Book," 1872, p. 48, and shows the comparative death-rate of soldiers and civilians, per 1,000 living, at different ages.

The conclusion to be drawn from those figures and the accompanying graphic representation of them is, that the constitutions of English soldiers break up rapidly after a certain number of years' service, and that an army of men enlisted for life would eventually be largely composed of cripples and invalids.

XII. Long service has never suffered so severely from want of recruits and from desertion as short service; it is proof against the political and medical arguments before which life service justly fell in 1847; but in common with both, and indeed with every conceivable form of voluntary enlistment, it is open to three fatal objections. It can only supply us, at an enormous cost, with an army which, in point of quality, is the very worst we could raise in England, and which, numerically, is so feeble as to render it impossible for us either to defend the country sucessfully in case of invasion, or to play a fitting part in any continental war in which we may be involved.

XIII. During the year 1871 the number of recruits inspected in the United Kingdom was 36,212. "The rejections on primary inspection "amounted to 10,836, and on secondary inspection to 1,178."[1] In other words, about nearly 1 man in 3 was rejected. And what were the causes of these numerous rejections? The ratio per 1,000 for syphilis was 16; muscular tenuity and debility, 45; disease of the eyes, 45; disease of the heart, 26; disease of the veins, 18; loss of teeth, 12; hernia, 15; varicocele, 18; defects of the lower extremities, 16; and for malformation of the chest and spine, 26.[2]

"Taking the results of all the examinations," says the compiler of the Blue Book, "there has been a marked increase in the rejections for muscular tenuity and debility * * * and a notable decrease in varicose veins, defects of the lower extremities, and malformation of the chest and spine."[3]

In 1872, 8,990 recruits were rejected out of 28,390.[4]

"The most noteworthy change in the causes of rejection," says the compiler of the Blue Book, "is the increase in the ratio of rejections for muscular tenuity and debility, which in 1871 was much above the average of former years, and is now (1872) nearly double that average."[5]

Why have so large a number of men been rejected for such causes as those enumerated above? Because we are compelled now, and have always been compelled in emergencies, to enlist largely from town recruits of immature age.

1 "Army Medical Blue Book, 1871," p. 37. 2 Ibid., pp. 40, 41, 42.
3 Ibid., p. 43. 4 Ibid., 1872 (the last published), p. 49. 5 Ibid., p. 53.

We have ample evidence to show that town recruits were physically inferior to country recruits in the time of the Roman Empire.

"Fortior miles ex confragoso venit," says Seneca; "segnis est urbanus et verna. Nullum laborem recusant manus quæ ad arma ab aratro transferuntur; in primo deficit pulvere ille unctus et nitidus."[1] "It has never been doubted, I believe," says Vegetius, "that country folks are best adapted for carrying arms."[2] Experience proves that town recruits are still inferior physically to country recruits. In 1871, "the highest proportion of primary rejections (of recruits by the medical examiners) took place, as in the preceding year, at Manchester, Portsmouth, and Glasgow, and of secondary at Manchester, Birmingham, and Liverpool."[3] In 1872, "Manchester, Glasgow, Portsmouth, and Bristol furnished the highest ratio of rejections on primary inspection, and Manchester and Birmingham the highest on secondary inspection."[4]

Notwithstanding all this, we are compelled by necessity to enlist largely in cities. Of the total number of recruits inspected medically in 1871, 20·5 per cent. were inspected in London;[5] and in 1872, 31·7 per cent. of the men raised in the United Kingdom were enlisted in London alone, and 52 per cent. were enlisted in London, Manchester, Birmingham, Liverpool, and Glasgow.[6]

"Of late years," said Mr. Wyndham in 1806, from his place in the House of Commons, "our only resource has been recruiting boys. Men grown up, even with all the grossness, ignorance, and improvidence incident to the lower orders, are too wary to accept our offers; we must add to the thoughtlessness arising from the situation the weakness and improvidence of youth."[7] Very similar in substance are the words of the Recruiting Commissioners of 1859. "Although authority was given, nearly three years ago, in consequence of the mutiny in India, to raise an additional number of 65,000 men, and although, in order to facilitate that operation, the bounty was increased, and the standard—as is unavoidable when so many men are required—was lowered to such an extent as to bring boys instead of men into the ranks, the establishment of the army is not quite complete."[8]

In 1871, 18·1 per 1,000 recruits enlisted were under seventeen years of age, and 576 were under twenty.[9] The corresponding figures in 1872 were 27 and 582·3.[10]

It appears that we enlisted fewer boys in 1873 than in 1845. "In " 1845, out of 1,000 recruits, 750 were under twenty years of age, " whereas in 1873 there were only 580 per 1,000."[11] Unfortunately, the boys of seventeen we enlisted in 1845 "were superior in *physique* " to the majority of the recruits of eighteen we are now accepting."[12] As a proof of this, Dr. Adams gives a table of heights for 1845 and 1873, which I have supplemented, in Table F in the Appendix, by a

[1] "Epist." 51.
[2] "De Re Militari," p. 4.
[3] "Army Medical Blue Book," 1871, p. 38.
[4] Ibid., 1872, p. 49. The reason is palpable. "Almost every class of artificers is subject to some peculiar infirmity, occasioned by excessive application to their peculiar species of work." "Wealth of Nations," i. 86, Rogers' ed.
[5] "Army Medical Blue Book," 1871, p. 38.
[6] "General Annual Returns," 1874, Table 13.
[7] "Alison's "History of Europe," vi. 108, note.
[8] "Report of the Royal Commission on Recruiting," 1861, p. 3.
[9] "Army Medical Blue Book," 1871, p. 43.
[10] Ibid., 1872, p. 53.
[11] Dr. Leith Adams, F.R.S., on "The Recruiting Question," in the *Journal*, R.U.S. Institution, vol. xviii., No. 76, p. 62.
[12] Ibid.

column showing the heights some fifty years ago, as given by Mr. Brent, F.S.S., in Marshall's "Military Miscellany," p. 89.

The next Table, G, showing the comparative weights of the recruits in 1871 and 1872, is compiled from the Medical Blue Books of those years.

These figures fully warrant Dr. Adams in concluding that

"we have been driven more or less to select soldiers from among a class of the population notorious for containing elements of physical degeneracy. * * * There is altogether a want of vigour 'in the city boy-recruit,' and that healthy promising aspect which should characterise a youth of his years."

The increase of these manikins in the ranks of the Army had already excited attention in 1872.

"There are a large number of men, or rather lads, now in the service," wrote Dr. Tuffnell in that year, "who must break down if put to the hard work and heavy exertion inseparable from war. Many of those who have been under confinement during the past twelve months have been weakly and ill-framed, without muscle, bone, or courage, crying like women in their cells. An inspection of every regiment, each man stripped naked as they are upon admission into prison, would, I feel assured, exhibit many individuals in the ranks who are never likely to become efficient soldiers."[1]

The Inspector-General of Military Prisons refers to this matter in his Report, 1873:—

"The extracts from the report of the medical officer of Millbank," he says, "will show that many of the men admitted had to be exempted from hard labour on the ground of original defects of development, feebleness of frame and constitution, and a tendency to chest affections."[2]

It seems to me, then, that Dr. Adams is completely justified in inferring from these facts,—

"that the number and quality of recruits have been steadily decreasing of late years, more so since the introduction of short service, and the doing away with pension and bounty on enlistment * * * the *physique* of our Infantry is not at present up to the standard of our race; and I cannot conceal from myself a feeling that, unless remedial measures are adopted, it will sink lower and lower. This conclusion has been arrived at mainly from my personal inspection of about 25,000 recruits, over 17,000 of whom have been passed into the army."[3]

This evidence of a medical officer, who can have no possible interest in playing the part of Cassandra, would, in my mind, be conclusive, even if it were not backed up by the testimony of almost every Artillery and Infantry officer in the Army. The Cavalry still get fair recruits; but these respectable lads soon discover the mistake they have made in enlisting, and they are not slow in endeavouring to repair it. The mean rate of desertion for five years (1868–72) was 27·4 in the Cavalry, against 22·6 in the Artillery and 20·6 in the Infantry.

The moral qualities of our present soldiers may be judged of from tables H and I.

It will be observed that the system of discharging notorious bad characters has done little to diminish crime.

It may be said that the returns of courts martial show a very decided

[1] "Report of Inspector-General of Military Prisons, 1872," p. 15.
[2] Ibid., 1873, p. 5.
[3] *Journal*, R.U.S. Institution, vol. xviii. No. 76, p. 64.

diminution, and that consequently crime is diminishing in the Army. I admit the fact, but I deny the conclusion. The diminution in the number of courts martial is due to three obvious causes.

The first cause is the system of fining for drunkenness. Table J shows the number of courts martial for habitual drunkenness from 1865 to 1868. Very naturally, when fining for drunkenness was substituted for trial by court martial, the number of courts martial diminished.

The second cause is, that the men are more immediately governed by the officers than they used to be.

The quality of the non-commissioned officers must vary with the quality of the men from among whom they are selected. The quality of the men is deteriorating, and consequently the non-commissioned officers are less efficient than they used to be. The command of the men has, therefore, been thrown more and more upon the officers, and the result has been a certain diminution of crime, because men always obey officers more readily than non-commissioned officers.

The third cause is the increasing mildness of our rule. Every month, scores of men are dealt with regimentally, who fifty, even twenty years ago, would have been tried by court martial.

As to the intellectual qualities of the recruits, the number who can read and write is necessarily increasing year by year, in consequence of the progress of education in the country generally. For the education of those who are illiterate, Government spends annually a large sum on Army schools. This amounted in 1872 to £139,400; in 1873 to £133,900; and in 1874 to £135,200.

The inevitable conclusion forced upon us by these facts is that physically, morally, and intellectually, our Army is the worst we could raise in England.

It may be objected that my facts exclusively relate to our soldiers of the present moment, and that their degeneracy, physically, morally, and intellectually, is entirely due to the Short Service Act of 1870.

In the first place, I deny that my facts exclusively relate to our present soldiers.

In the second place, while admitting that the Short Service Act of 1870 may have to some extent accelerated the downward progress of the voluntary system, I deny that it has done more. The progress of industry, not an Act of Parliament, is the true cause of the decay of the voluntary system.

The tendency of the voluntary system to absorb the dregs of the people, showed itself universally throughout Europe from the very infancy of standing armies.

"Les volontaires," says Machiavelli, who wrote in the latter part of the fifteenth century, "ne sont pas les meilleurs d'une province, au contraire ce sont les pires; parceque s'il y en a de scandaleux, de fainéants, de réfractaires, de libertins, d'échappés de la maison paternelle, de blasphemateurs, de joueurs, en un mot, de mal élevés, ce sont ceux-là qui veulent aller à la guerre, et tous ces défauts font une forte méchante milice."[1]

"If all infamous persons, and such as have committed capital crimes, heretics, atheists, and all dastardly and effeminate men," wrote Bruce in 1717, "if all these, I say, were weeded out of the armies that are at present on foot in Europe, it's

[1] French Trans. of his "Art of War," p. 42.

much to be feared that most of them would be reduced to a pretty moderate number."[1]

In the middle of the 18th century, we find Frederick the Great's army composed of similar materials. Prisoners just discharged from prison and renegades of all classes formed the largest part of the Prussian army, and the most extraordinary precautions had consequently to be taken against desertion.[2]

The Austrian army was composed almost exclusively of serfs at this time.[3]

A foreign writer describes the English army at the beginning of the present century in the following words:—

"Die Engländer behielten für ihre Heerbildung die frei Werbung bei, obgleich in der Regel nur aus Engländern, recrutirten sie ihre Armee doch fortwahrend wie alle Machte wahrend des 18 Jahrhunderts, aus dem Abschaume des Volkes."[4]

The fact that three of the regiments we sent out to the Peninsula consisted wholly of convicts, pardoned "on condition of being trans-" ported beyond the seas, or of listing themselves in the service of His " Majesty in his army or navy,"[5] is a sufficient justification for Rüstow's remark. This tendency of the voluntary system to absorb the dregs of the population is the necessary consequence of the rapid progress of industry in modern Europe.

What ever drove, or now drives, a man to enlist as a private soldier? Poverty.

"It is poverty makes men soldiers," said Defoe; "and drives crowds into the armies; and the difficulty to get Englishmen to list is because they live in plenty and ease; and he that can earn 20*s.* a-week, at an easy, steady employment, must be drunk or mad when he lists for a soldier, to be knocked o' the head for 3*s.* 6*d.* a-week."

We draw our soldiers from the poor, and who are the poor? Those who, under the inexorable law of Natural Selection, fail, from some physical, moral, or intellectual defect, in industrial pursuits. When industry was in its infancy, and its prizes were few, there was a large mass of the population from which recruits might be drawn. The more industry spreads, and the greater the number of its prizes, the smaller is the *residuum* from which recruits can be got, and the worse, physically, morally, and intellectually, does that *residuum* become.

In quality, then, our army is the worst that we could raise; the worst, too, at a time when Tactics are undergoing rapid changes, and each change demands a corresponding improvement in the quality of the individual soldier. Every improvement in the Mechanical Arts, every discovery in Chemistry and Metallurgy, must eventually lead to an improvement in fire-arms; and every improvement in fire-arms necessarily involves a corresponding change in Tactics. We fought in column with the old flint-musket; Brown Bess enabled us to fight in line; breech-loaders compel us to fight in skirmishing order. The new order may demand no higher physical qualifications in the soldier than were demanded by the old order of things, but it demands at least

[1] "Institutions of Military Law."
[2] Rocquancourt, "Hist. de l'Organisation, &c., Militaire," ii. 42.
[3] Preface of Lloyd's "Hist. de la Campagne de 1756," p. 40.
[4] Rüstow's "Geschichte der Infanterie," ii. 332.
[5] Clode, ii. 14.

as high; and yet our soldiers are degenerating physically. The new order, however, unmistakeably calls for higher moral and intellectual qualities.

"The effect of the invention of breach-loaders," says General Sherman, "is, that companies and battalions will be more dispersed, and the men will be less under the immediate eye of their officers; and therefore a higher order of intelligence and courage on the part of the individual soldier will be an element of strength. * * * The more we improve fire-arms, the more will be the necessity of good organisation, good discipline, and intelligence on the part of the individual officers and soldiers."[1] "The truth made manifest at Sadowa and Sedan—so manifest, that those who run may read—is that moral and intellectual qualifications are elements in the strength of armies, and elements which can only be obtained when armies derive their materials from the whole range of the community from which they are drawn."[2]

Such are the words of a Professor of Political Economy,—words of serious import, for the moral and intellectual value of our army is as low as it could well be.

XIV. Let us now inquire into the cost of the army composed of such materials.

The Army Estimates for 1853-4, neglecting the auxiliary forces, amounted to £9,501,679, for 119,874 men. In 1874-5, the corresponding estimates amounted to £12,912,618 for 128,994 men. The total cost of each man, therefore, was £79 in 1853-4 against £100 in 1874-5. While we are thus paying £100 for the dregs of the community, the Prussians are paying no more than £42 for their average citizens.[3] Is the price of our soldiers likely to increase?

The various votes of which our estimates consist may be divided broadly into two categories: first, those relating to the *matériel*, and secondly, those relating to the *personnel* of the Army.

In his chapter on the cost of defence, Adam Smith attributes the increasing expense of modern war chiefly to the increasing cost of the *matériel*.[4] M. Comte corrects this mistake at some length in his "Philosophie Positive," and points out that the increasing expense of war is entirely due to the increasing cost of the *personnel*.[5] A glance at the estimates is sufficient to prove that M. Comte is correct. The votes for *matériel* in 1853-4 amounted to £1,345,437, and in 1874-5 to £1,528,300. In other words, they amounted to about one-eighth of the total estimates. During the last three years they showed a marked tendency to decrease, but they cannot fall below a certain limit. Every year brings us new discoveries and inventions, which lead to improvements in explosives, rifles, and guns; and changes in guns necessitate changes in fortifications. They may vary, perhaps, from one-seventh to one-tenth of the total estimates; but whatever be the range of their variation, the loss or gain on these votes is far too small to affect seriously the total amount of the estimates, and I shall assume that these votes remain constant. The cost of the *personnel* has been steadily increasing since the introduction of standing armies. Will it continue to increase? If it does increase, it is evident that the cost of the *matériel* being,

[1] New York *Army and Navy Journal*, Sept. 1874.
[2] "Political Essays," by Prof. Cairnes, p. 234.
[3] "Statesman's Year Book," 1874, pp. 96, 97, 100.
[4] "Wealth of Nations," ii. 291. [5] Ibid., vi. 62.

practically speaking, constant, the amount of the estimates will increase in the same proportion as the cost of the *personnel*.

I have already pointed out that, in consequence of the State being thrown upon the labour market for its supply of recruits, and being obliged to compete there with other employers of labour, the rate of the wages of labour determines the rate of the soldier's pay. Now the wages of labour have been for a long period surely, although slowly, rising, and there can be no reasonable doubt that they will continue to rise. Therefore the income of the soldier, which is governed by the labourer's wages, must rise.

It may be said that the gradual increase in the wages of labour has been only nominal, not real; the rise being due to the growing prosperity of the country at large and the consequent diminution of the value of money. This objection is tantamount to saying that the condition of the labourer has not improved for, say a century; for if the rise in his wages has been only proportional to the fall in the value of money, he is clearly no better off now than he was when Adam Smith wrote. I cannot here enter into questions of Political Economy: suffice it to state, upon the authority of an eminent political economist[1]—first, that the well-being of town labourers is considerably greater now than it was a century ago; secondly, that the condition of the great majority of country labourers is better than it was then; thirdly, that the comparative condition of the small minority is a moot point, being no worse, if it be no better; and lastly, that there is a high probability that the well-being of all labourers will surely and steadily increase.

The gradual increase in the labourer's wages, then, will necessitate a corresponding increase in the soldier's income, even supposing that the improvement in the labourer's condition produces no change in the feelings with which he regards military service. But if any one historical fact is better established than another it is, that as the industrial spirit increases, the military spirit decreases, at all periods and in all climes.

"All political investigation of a rational kind," says M. Comte, "proves the primitive tendency of mankind, in a general way, to a military life; and to its issue in an industrial life. No enlightened mind disputes the continuous decline of the military spirit, and the gradual ascendancy of the industrial. We see now, under various forms, and more and more indisputably, even in the very heart of armies, the repugnance of modern society to a military life. We see that compulsory recruiting becomes more and more necessary, and that there is less and less voluntary persistance in that mode of life."[2]

If M. Comte's evidence be considered insufficient, let us turn to figures. Table K shows the number of adult able-bodied paupers in England and Wales from 1859 to 1873. Assuming half these adult able-bodied paupers to be males, it appears that about three times the number of men required annually to fill the gaps in our ranks are eating the bread of idleness at the public expense. It may be said that these men are idle miscreants, who betake themselves to the workhouse simply from a love of idleness. Let it be granted that two-thirds of the able-bodied male paupers belong to this class, and that the remain-

[1] Professor Cairnes.

[2] "Philosophie Positive," translated by Martineau, ii. 173.

ing third are driven to the workhouse by *bonâ fide* want of work. Why do the latter prefer the workhouse (which, as everybody knows, is hateful to all respectable labourers) to the army? Because they look on the workhouse as the least of two evils. They dislike the workhouse, but they dislike the army still more. This is a good illustration of the dislike of the lower classes for military service. Tables L, M, N, and O show the kind of feeling with which those who have actually enlisted regard military service. What better proof could we demand of "the "repugnance of modern society to a military life," displayed "even in "the very heart of armies?" To resume: as civilisation progresses, the military spirit gives way before the industrial. The better the condition of the labourer, the greater will be his aversion to military service; and the stronger this aversion, the greater will be the inducements necessary to allure him into the ranks. The income of the soldier, therefore, has a tendency to rise in a higher ratio than the wages of labour: for, in the first place, the soldier must receive a sum which is at least equal to the wages of labour and which rises with them, as a compensation for the work he does and the risks he runs; and, in the second place, he must receive another sum, in excess of the wages of labour, which also rises as wages rise, as compensation for the declining reputation of military service. Professor Cairnes puts this very clearly:—

"The State being thrown for the supply of soldiers on the labour market, and the soldiers' vocation being, fortunately for mankind, one that with the progress of society steadily declines in public estimation, two important consequences result: first, in order to attract a sufficient supply of men to the ranks, the Government is under the necessity of constantly raising its terms—of raising them, not merely in proportion to the general advance of the labour market, but so as to compensate the declining honour into which the soldiers' trade has fallen: and secondly, the recruits, thus attracted, come more and more from the lowest and least respectable classes of the community. The system thus becomes constantly more costly; while the character of the men who fill the ranks steadily deteriorates."[1]

The cost of the soldier, then, will inevitably rise, and will continue to rise. I do not mean to assert that it will rise either rapidly or continuously. It may fall next year, and the year after too. What I maintain is, that in the periods of time required for the operation of large social causes, the Army Estimates will prove an ever-increasing burden to the people of England, and that in no very distant future the burden will become altogether insupportable.

It only remains to consider the value of our Army numerically.

XV. It might be reasonably expected that our lavish military expenditure, unparalleled in history, would have at all times brought us a sufficient supply of recruits. As a matter of fact, however, the ranks of our army have seldom or never been complete, except in times of reduction. To take a few instances in the present century:—The army was 25,000 men below its establishment in 1806;[2] 32,314 in 1814;[3] 7,949 in 1826;[4] 7,643 in 1831;[5] 5,737 in 1866;[6] 9,280 in 1871;[7] and 3,128 in 1873.[8]

[1] "Political Essays," p. 209. [2] Alison's "History of Europe," vi. 112, note.
[3] Marshall's "Military Miscellany," p. 350.
[4] Ibid. [5] Ibid. [6] "General Annual Returns," 1874, Table 1.
[7] Ibid. [8] Ibid.

The number of recruits, then, is insufficient; it has been so insufficient that in all our great wars, the Crimean included, Government has been obliged to employ foreign mercenaries; and for nearly a century we were driven to have recourse to limited conscription.

"The first Act directly sanctioning the employment of foreigners as "part of the military forces of the Crown was 29 Geo. II., c. 5."[1] The next was 34 Geo. III., c. 43. Not more than 5,000 of these mercenaries were permitted to be in England at one time.[2] The next was 40 Geo. III., c. 100, authorising the Crown to employ 6,000 Dutchmen.[3] Again, the preamble of 44 Geo. III., c. 75, states that it was desirable to employ foreigners,[4] 16,000 of whom were eventually permitted to be in England at the same time. Table P, extracted from Clode ii., 436, shows the number of foreigners in British employ from 1804 to 1813.

Finally, a force of foreigners was raised under 18 Vict., c. 2, during the Crimean war. It was a comparatively small force, and is the last that can be employed by England.

But the supply of foreigners was at all times precarious, and sometimes failed altogether. Under these circumstances the English Government was driven to its last and only resource; and it became necessary to compel the patriot citizen to serve his king and country. It is a stern fact that limited conscription was resorted to, in our free and glorious country, on almost every occasion on which troops were required from 1695 to 1781. It was limited to imprisoned debtors from 1695 to 1702;[5] it was applied to criminals in 1702;[6] and it was extended to paupers in 1703.[7] Mr. Clode describes 7 Anne, c. 2, which was passed in 1708, as an Act "to stimulate voluntary enlist-"ment under the apprehension of impressment."[8] I prefer to call it an Act under which conscription received an unlimited extension in its application to that large and vague class—the pauper class.

> "By this Act the Commissioners were first to appoint two General Meetings for Volunteers to be received and paid £4 as bounty. After these meetings impressed men were to be brought in and listed, receiving no bounty. For each listed man the reward to the parish officers was increased to £1, and the churchwardens were to receive £3."[9]

Whatever doubt there may be as to the true meaning of this Act, there can be none about the meaning of 29 Geo. II., c. 4, which Mr. Clode speaks of as "one of impressment only, not embracing volun-"tary offers of service."[10] In plain language, conscription was put in force, under this Act, in its barest and most unmistakeable form, though it was restricted, no doubt, to men not following any "lawful "calling or employment," or not "having lawful and sufficient "support."

I must repeat that these conscriptions were limited, or class conscriptions. They were, therefore, both vicious in theory and tyrannical in practice, being founded upon the monstrous principle, that in

[1] Clode, ii., 432. [2] Ibid., ii., 433. [3] Ibid., ii., 434.
[4] Ibid.
[5] Ibid. ii., 12. [6] Ibid., ii., 13. [7] Ibid., ii., 15.
[8] Ibid. ii., 16. [9] Ibid. [10] Ibid., ii., 17.

emergencies some men are bound to serve their country and some are not.

It would be impossible, in the limits prescribed for this essay, to trace the progress of the laws of conscription. Suffice it to say, that although conscription for the regular army has not been resorted to since 1781, the principle that every able-bodied man is bound to serve his country in time of need was affirmed by the law of 1757, 30 Geo. II., c. 25, which authorised the Crown, in certain emergencies, to recruit the militia by ballot[1]—a law, which with more or less modification, has been in force up to the present moment.

"Even now," says Professor Cairnes, "the permanent law of the country requires that everyone (with specified exceptions) shall, if called upon, venture his body in the Militia, and only fails of being enforced through the enactment of an annual Act suspending the Militia ballot."[2]

It may be urged that, granting the great difficulty of getting recruits, it is a difficulty which has always existed, and is no greater now than it ever was, as is proved by my own figures. This is not so. Admitting, for the sake of argument, that the number "wanting to complete" did not materially increase between 1851 and 1871, the difficulty in getting recruits can only be said to have remained the same by assuming the number of men available for recruits in the United Kingdom to have been constant during that period. But this assumption is quite untrue.

"If there was a conscription of young men at twenty," wrote the Census Commissioners of 1871, "the annual contingent furnished by England and Wales would be about 207,943, who, if they continued under the flag five years, would amount to 1,017,862. * * * The number living is continually increasing: thus the number of young men attaining the age of twenty in 1851 was 171,812, and 207,943 in 1871; so if the recruiting staff does not get volunteers in that proportion, it is not for lack of men, but of inducements to serve."[3]

But, even supposing our establishment to be complete, is that establishment sufficient to maintain the position—to say nothing of the honour—of England as one of the great European Powers?

On the 1st January, 1873, our Army numbered 194,227 officers and men. But where were they? There were 62,834 in India; 1,373 on their passage from India; 23,590 in the Colonies, and the remaining 103,618, of whom 62,334 were Infantry, at home. Thus the grand result of our expenditure of some £15,000,000 was, that the safety of the British Islands was staked upon an army of less than 60,000 Infantry. What of our ancient constitutional force, the Militia, it may be asked, forming, as it does, a reserve of 120,000 men? I never hear of the Militia without thinking of Dryden's description of the trained bands of his times:—"In peace a charge, in war a weak defence." Officered, instructed, and disciplined as it is, the Militia is not a reliable force now; and it can never become so, for the simple reason that it is raised, like the army, on the voluntary system. I may be reminded, too, of our Yeomanry Cavalry. I would as soon believe in the transmutation of the metals as in the transmutation of a civilian into a Cavalry

[1] Clode, i., 39.
[2] "A National or a Standing Army?" in "Political Essays," p. 231.
[3] "Report of the Census, 1871," p. 12.

soldier by means of eight days' training in the year. But we have 180,000 citizen-soldiers, it may be urged. I know something of the Volunteers, and my conviction is, that the only end gained by supporting them is the gratification of our national vanity. Not long ago an Austrian officer irreverently described them as "a "harmless joke."[1] They may be a joke, but they are certainly not a harmless one, for they are filling the country with an army of mock colonels and majors who, if an invasion did take place, would cause incalculable harm by the tenacity with which they would cling to their relative rank.

Finally, we have no reason to place any trust in such a Reserve as that now being formed. In the first place, the practical difficulty of collecting the men, in a country socially organised like England, would be enormous. Secondly, the great majority of the men have avowedly a distaste for military service, and not half of them, probably, would obey the summons to muster. Lastly, the military value of the fraction of the Reserve which we might succeed in collecting would be *nil*, for owing to the impossibility of organising regular annual drills and exercises for such a force, and also to the constant changes in military manœuvres, the men who answered the call and rejoined the colours would be little better than raw recruits. They would come together ignorant of each other, of their non-commissioned officers, and of their officers; and for a considerable time they would be no better than a military mob, which, as Lord Macaulay says, is the worst of all mobs.

I need hardly say, that the direct consequence of our want of Reserves is, that in case we became involved in hostilities we should be obliged to fill up the gaps in the ranks of the army in the field with raw recruits. "The reinforcements we are getting," wrote Sir John Burgoyne, from the trenches round Sebastopol, "consist of a vast "number of recruits. . . I think that we are better without *numbers* "than that they should be so composed."[2]

XVI. I sometimes think that Bishop Butler's theory of national fits of insanity must be true, and that we English are gone mad upon the subject of our national defences. For surely it is sheer madness to risk our liberties in times like the present upon the success of an army of 60,000 infantry. In Marlborough's, in Wellington's time, such a force might have proved sufficient for our needs, but at present it is utterly unfit to fulfil its *raison d'être*, for we live in times when heaven favours big battalions more than ever it favoured them. "The new "weapon," said Sir William Napier, speaking of the Enfield rifle, "will be all in favour of superior numbers."[3] Our present weapon is still more in favour of superior numbers, and superior numbers we never have had, and never can have with a voluntary system of enlistment.

Let us hear the conclusion of the whole matter in the words of Professor Cairnes:—

"The capital fact of the case is that the method of warfare has been changed,

[1] Streffleur's "Oesterreichische Militairische Zeitschrift," for May, 1874, p. 166.
[2] "Life and Letters," &c., ii. 206. [3] "Life," &c., ii. 378.

The struggle has been transferred from standing armies to armed populations; and until we recognise this fact, and adapt our defence to the altered circumstances, our position cannot be other than precarious. * * * It may be that warfare carried on by entire populations is 'essentially retrograde'; but retrograde or not, this *is* the danger against which we have to provide. And it seems to me there would be as little solace to our dignity as compensation for our suffering, on finding ourselves the victims of combinations we might easily have foreseen, to reflect that we had only made our preparations against more civilised methods of attack. * * * * In very truth it signifies little whether our present method of recruiting be effectual or not; for were we thus to obtain an army numerous enough for our purpose, the expense of such a force, maintained on the principle of a standing army of the English pattern, would be simply ruinous. Our entire revenue applied exclusively to military purposes would not suffice for the drain; and we might as well be crushed at once by the enemy as ruined by the slow torture of the taxgatherer. And I venture to go further still. Even though the needful force could thus be raised, and the means of supporting it were forthcoming, what just confidence could be placed in an instrument of the quality which alone such a process could give us? The system remaining the same, the character of the men composing our army would continue to be what it now is; and we should thus, in the last resort, have to stake our national existence on a struggle in which the *prolétaires* and the pariahs of our community would be matched against the average citizens of other states."[1]

The voluntary system of recruiting never was a success, and day by day it must prove a greater and a greater failure. The reader may perhaps remind me of the glories of the past. If he points on the one hand to the records of our victories, I point on the other to the records of our national debt. With a better system of recruiting, we might have won the same victories at one-third of the expense. Prussia's motto is "Blut und Eisen"; "Blood and Gold" is England's. But gold is a dangerous metal to put one's whole trust in. "Solon said "well to Crœsus (when in ostentation he showed him his gold), 'Sir, "'if any other come that hath better iron than you, he will be master "'of all this gold.'"[2]

Part II.—On Systems of Recruiting in General.

I. There are only four possible systems on which recruiting can be carried on; the voluntary, the mercenary, the vicarious, and the compulsory.

II. In Part I. I have endeavoured to prove that it is hopeless to expect a good army from the voluntary system, either now or at any future time.

III. It would be impossible, in the present political state of Europe, for any country to maintain an army of foreign mercenaries.

IV. The recent rejection of the vicarious system by the French is, in my mind, a sufficient argument against its adoption elsewhere, even were we ignorant of the facts of the case. But we are well acquainted with the facts of the case, and they, one and all, prove the vicarious system is a splendid sham.

On the 20th August, 1793, the first "levée-en-masse," or universal conscription, known in modern history was voted by the French National Assembly.[3] Universal conscription was declared the recog-

[1] "Political Essays," pp. 219, 222, 223.

[2] Bacon's "Essay on the true Greatness of Kingdoms and Estates."

[3] "Les Institutions Militaires de la France," par M. le Duc d'Aumale, p. 53.

nized system of enlistment in 1798, and substitution was forbidden. Substitution, however, made its appearance the very next year.[1] The history of substitution from that year until 1855 is best told in the words of the French Committee on Recruiting, 1871.

"As luxury spread in France, and new pursuits were opened up for young men, they seemed less ambitious of following the profession of arms; the number of substitutes increased, and the means employed to obtain them occupied public attention, and more than once motions on this subject were introduced into the Chambers."[2]

In 1855 the law of dotation put an end to substitution. The only difference between substitution and dotation was this; that under the former system a man designated for military service was allowed to pay another to serve in his stead, while under the latter a man could buy him himself off military service altogether, and thus compel the State to provide another in his place, if another was wanted. Substitution was bad; dotation was worse; and under both systems conscription was a mere name, for both virtually did away with personal service. In 1865-66, "the number of that portion of the army "not furnished by the conscription had risen to 283,000, of which "number 164,000 were Government substitutes—men engaged or re-"engaged for money."[3] To such a pass had things come, indeed, that private companies were formed to insure their subscribers against "fire, inundations, storms, and military service."[4]

Owing chiefly to Trochu's indignant protest, dotation was abolished in 1868; but substitution reappeared, and exchange of lots was allowed. Then came the war, and with the war, defeat. But, as the French Committee tell us, "Great disasters carry with them much instruction. "It is wise to understand them; it is courageous to profit by them."[5] The realities of war dispelled the illusions of peace; the Committee on Recruiting perceived clearly that "the question of substitution is truly "the question of compulsory service;"[6] and acting upon this principle they established as the system of recruiting universal conscription, without substitution or dotation.

It is evident that the necessary effect of the French, or vicarious, system is the elimination of the best classes from the ranks.

"A mesure qu'un plus grand nombre de familles arrivent à l'aisance, le chiffre des exonérations augmente, et l'armée ne se recrute plus que dans les dernières classes de la population."[7]

Such was the result in France; such, too, was the result in Belgium.

"In 1866, as we are informed by M. Fourcault,[8] the proportion of substitutes formed no less than a fourth of the whole annual contingent—a proportion more than double what it had reached ten years before."[9]

1 "The Law of Recruiting," translated from the French by Capt. Home, R.E., p. 4.
2 Ibid., p. 7.
3 Ibid., p. 8.
4 Trochu's "L'Armée Française en 1867," p. 59.
5 "The Law of Recruiting," p. 1.
6 Ibid., p. 23.
7 "La Prusse et l'Autriche depuis Sadowa." Par M. de Laveleye, i. 74.
8 "Annales de l'Association Internationale: Congrès de Berne," 1866, p. 692.
9 Prof. Cairnes' "Political Essays," p. 215.

Such also was the result in England on one of the first occasions on which the ballot for the militia was enforced.

"The principle of substitutions led to this result," says Mr. Clode, "that few *but substitutes* were to be found in the ranks. The evil did not, however, terminate here; for temptation to procure another high bounty by another substitution led to a large amount of desertion. The returns laid before Parliament, under the Army of Reserve Act, showed that out of the 45,492 men raised for the United Kingdom in the years 1803-4, by the operation of the ballot, 40,998 were substitutes, and further that in one year the force was reduced by desertion and death by 8,106 men."

The deaths only numbered 599. Similar results were shown at a later period.

"From returns laid before Parliament in March, 1808, it appeared that, of 26,085 raised since the 14th August preceding, 22,956 men were substitutes, only 3,129 being principals."[1]

A vicarious army, then, is a mere sham. A conscription in name, in reality it degenerates into a voluntary army, composed of substitutes bought at a great price. The men composing it belong "almost "exclusively to a single class, and that the lowest of the nation;"[2] it gives rise to an incalculable amount of desertion; and it renders impossible the formation of large and reliable reserves. The French have rejected it, and wisely rejected it, as a perusal of Captain Home's translation of "The Law of Recruiting" will prove. To adopt it in England would be to make our last state worse than our first.

V. Nothing remains for us, then, but universal conscription, without substitution or dotation; a system which will furnish us with a first line and large reserves, composed of the flower of our population, at about one-third of the cost of our present army.

VI. It may be said that conscription is unnecessary, for two reasons.

The first is, that the wages of labour are rising, High wages mean early marriages, and early marriages mean a redundant population, which will furnish an ample supply of recruits. This is tantamount to saying that the condition of the labourer can never improve—an objection I have met before.

The second reason is, that the collapse of the voluntary system is owing to the mal-administration of "the authorities"—meaning, I presume, the Commander-in-Chief and his staff. His Royal Highness has about as much to say to the collapse of the voluntary system as the Tycoon of Japan. Its collapse is due purely and entirely to the progress of the industrial spirit in the country, and the corresponding changes in the conditions of society; and if we are to remain what we now are, a great and free people, we must adapt ourselves and our institutions to these new conditions. We were the last nation in Europe to raise a standing army. We fought long and resolutely against it, but we were at last compelled by the force of circumstances to give in. We are the only great power in Europe that does not maintain a compulsory army, and we shall, no doubt, fight resolutely and long against it. But we shall be compelled to give way; conscription is inevitable. Let us yield to the arguments of common sense, rather than to the brute force of some great calamity.

[1] Clode, i. 291. [2] Professor Cairnes' "Political Essays," p. 216.

VII. Again, it may be said that conscription will injure the commercial prosperity of the country, by absorbing a larger amount of useful labour than the voluntary system.

In the first place, conscription, in its worst form, would hardly do more harm to our commerce than one serious reverse to our arms would cause.

In the second place, I doubt if conscription would absorb a greater quantity of labour than our present system. The quality of the labour would no doubt be higher; but let us ponder over the words of the French Commission on organisation :—

"The army is the annual premium of insurance against foreign invasion and dismemberment of territory. You cannot diminish the premium without diminishing at the same time the safeguards of the country. Forgetfulness of this fact cost us two of our most patriotic provinces and five milliards."[1]

VIII. It may be urged that conscription will retard our political progress by interfering with individual liberty.

"The very existence of a nation as an organised community," says Professor Cairnes, "is founded upon the recognition of duties obligatory upon all, and which the State may at need enforce."[2]

What duties can the State demand from every member of society, without trenching upon individual liberty? Let us take the answer to this question from a book advocating so great an extension of individual liberty, that the practical adoption of its principles, we have often been warned, would lead to revolution and anarchy.

"Every one who receives the protection of society owes a return for the benefit, and the fact of living in society renders it indispensable that each should be bound to observe a certain line of conduct towards the rest. This conduct consists, first, in not injuring the interests of one another, or rather certain interests, which, either by express legal provision or by tacit understanding, ought to be considered as rights; and secondly, in each person's bearing his share (to be fixed on some equitable principle) of the labours and sacrifices incurred for defending the society or its members from injury and molestation. These conditions society is justified in enforcing, at all costs to those who endeavour to withhold fulfilment."[3]

IX. Finally, it may be urged that the people of England "won't stand" conscription. Perhaps not,—at present. But conscription is coming upon us with sure, although slow foot.

If peace lasts long enough, we must eventually reach a time when the cost of an army, unfit for the operations of modern war, will be a burden no longer tolerable.

If war breaks out, we shall have to choose between conscription on the one hand, and defeat and humiliation on the other. Our house is founded upon the sands, and when the storms of war descend upon it, it must fall, and great will be its fall.

Conscription is inevitable.

X. It may be urged that, even if conscription were accepted by the people of England, a considerable time would necessarily elapse before it could be introduced into the army, and it may be asked what we are

[1] "General Organisation," translated from the French by Major C. B. Brackenbury, R.A., p. 3.

[2] "Political Essays," p. 230.

[3] Mill's "Essay on Liberty," p. 44, People's Ed.

to do in the meantime. We have two things, and only two things to do.

In the first place, we must raise the soldier's pay, which, as Table Q shows,[1] was less than the labourer's pay in 1869, and is considerably less than the labourer's pay now, by such an amount as will compensate, not only for the work and risk a soldier undergoes, but also for the declining estimation in which the Army is held by the labouring classes. And how, it may be asked, is this amount to be practically ascertained? Simply by going into the labour market and saying to the labourers, "If you won't come for the "pay and pension we offer you, what will you come for?" and by giving what they ask. In the second place, we must devise some equitable scale of payment for the different arms of the service. From a number of calculations I have made, I find that a Cavalry soldier does half again as much work in a given time as an Infantry man. Yet the latter receives 1*s.* a day pay, while the former receives only 1*s.* 2*d.* This crying injustice brings its own reward:—the desertion from the Cavalry is considerably higher than that from the Infantry. Irregular and capricious as the rate of desertion from the different branches of the service may seem at first sight, it obeys a very simple and intelligible law. The rate of desertion is proportional to the amount of work done in a given time, divided by the amount of pay received for that time. In general terms, if W and P be the amount of work done and pay received, in a given time, for one branch of the service, and D the average rate of desertion; and if W′, P′, and D′, be the corresponding quantities for another branch of the service,—then

$$\frac{W}{P} : \frac{W'}{P'} :: D : D'.$$

As an example, let the work done by an Infantry soldier in one day be unity. Then, since his pay is 1*s.* per diem, the value of the fraction representing his work divided by his pay, is unity. The comparative value of a Cavalryman's work would be 1·5 and this, divided by his pay, 1·16 shillings per diem, is 1·29. Now, 1·29 is to 1, as 1 is to 0·76, or as 27·4 is to 20·8; which was almost exactly the comparative mean desertion of the Cavalry and Infantry for the five years 1868-72.[2] This is a sufficient confirmation of the law I have pointed out.

It may be said that the desertion from the Artillery does not conform to this law. I reply that the figures representing the desertion from the Royal Artillery in the General Annual Returns represent nothing whatever. They are the averages of the desertion of the Field Batteries and Horse Artillery on the one hand, and the Garrison Artillery on the other; and as such they represent an imaginary rate of desertion, at which no Branch, Brigade, or Battery of Artillery deserts. We learn no more from these figures than we should learn from being told that the average height of the houses in a certain street was 50 feet,[3] or that the average height of two men was 5 feet 6 inches. In the first case,

[1] Extracted from Clode, vol. i. p. 489.

[2] "General Annual Returns," 1874, Table 22. The exact proportion is 27·4 to 20·6.

[3] I borrow this illustration from Venn's "Logic of Chance."

not a single house in the street might be within 20 feet of the average: in the second, the respective heights of the two men might be 5 feet 8 inches and 5 feet 4 inches, or 6 feet and 5 feet nothing. The desertion from the Artillery, however, forms no exception to the law I have pointed out. From the Police Returns of Deserters I find, that Field Artillerymen desert more than Cavalrymen. Why? Because, while the pay is virtually the same for the two arms, the Artillery have the hardest work. Again, the Garrison Artillery desert less than the Infantry. And why? Because while the work in both cases is the same, the gunner receives 2*d.* a-day more pay than the private. Nothing, then, can be more misleading than the averages representing the desertion from the Artillery in the General Annual Returns. According to them, the desertion of the Artillery is considerably less than that of the Cavalry, and somewhat more than that of the Infantry; while as a matter of fact, the Horse Artillery and Field Batteries desert more than the Cavalry, and the Garrison Artillery desert less than the Infantry.[1]

Part III.—On a Plan of Universal Conscription for the English Army.

I. As the best, and indeed the only possible, mode of providing recruits and forming reserves for the British Army, taking into consideration its varied duties in peace and war, I propose a home army, raised upon the principle of conscription in its most rigid form, without substitution or dotation, and an Indian and Colonial army maintained on the best form of the voluntary system—long service, with pension.

II. It may be said to be a monstrous contradiction, first to prove the voluntary system to be a failure, and then to propose a voluntary army for India and the Colonies. I reply, in the first place, that we have no choice in the matter. A conscript army is necessarily a short service army, and with such an army it would be practically impossible to organise a system of Indian and Colonial relief that would work. In the second place, by restricting the voluntary system to India and the Colonies, the value of one of the greatest objections to the voluntary system—its cost—is reduced to a minimum; while that of another—desertion—is reduced almost to zero. The force in India is roughly about one-third, that in the Colonies about one-eighth of the whole British Army. If conscription were adopted for the home army, therefore, the Imperial treasury would only have to provide for one-eighth, instead of two-thirds of the whole army on the voluntary system. As to desertion, it would be almost wholly got rid of.

"It appears," wrote the Royal Commissioners on Desertion in 1859, "that desertion is wholly confined to the United Kingdom, and the North American and Australian colonies. * * * At other stations, such as India, the West Indies, and the Mediterranean garrisons, desertion is very rare indeed, the proportion lost annually being little more than 1 per 1,000."[2]

[1] It is but right to say that these conclusions are drawn from partial facts. I believe, however, that they are closely approximate to the exact truth.

[2] "Report," &c. 1861, p. xii.

III. The home army of conscripts I propose to be divided into a first line, and a first and second reserve. What the strength of the first line and reserves should be I do not pretend to say.

As every man, according to my proposal, would be liable to military service, the annual supply of conscripts would far exceed our needs. The number required would be obtained by raising the standard of physical, and moral, and possibly intellectual efficiency, and by a judicious system of exemptions.

I propose the period of service in the first line to be one year.

Ten thousand military voices will, I know, exclaim—the experience of ages proves that you cannot make an Infantry soldier in one year.

In reply, I beg to say that we have no experience whatever in the matter. Our experience is entirely confined to the length of time required to make the lowest and worst members of the community soldiers. If they can be made soldiers in two years, there is no reason to believe that conscripts representing the whole mass of our population could not be made efficient in one year. The discipline would have to be rigid, no doubt, and the drill never-ending; but if the system were carried out with a will, no sane man can doubt its ultimate success.

As to the length of service in the reserves, I make no proposal.

Table R shows the manner in which Conscription might be introduced.

I have supposed, but do not propose, that the first line should consist of 100,000 men, and each reserve of 200,000. The latter would be called out for training each year for a certain time.

Conscription would be tried as an experiment, under chosen officers and non-commissioned officers, the first year, say 1877. Conscription would be again experimentally tried in 1878, 10,000 conscripts, only, being called out the first year, and 20,000, only, the second. I have supposed, but do not propose, that the conscripts pass their twentieth year in the first line.[1] As to the rate at which our present army and so-called reserves might be permitted to diminish, and other details, I trust the table is sufficiently explanatory.

IV. Such is the system I propose of providing recruits and forming reserves for the British Army, taking into consideration its varied duties in peace and war. It is the best means of doing so; it is the only means of doing so. Conscription may be unwelcome to the officers of the army, it may be irksome to the poor, and it may be hateful to the rich; but conscription is inevitable, because it is a logical and necessary consequence of the industrial progress of modern Europe.

[1] The age at which a man would join the colours would have to be determined by the nature of his profession or employment.

APPENDIX.

TABLE A.—SHOWING THE COST OF PENSIONS AT VARIOUS TIMES.

Clode's "Military Forces of the Crown," ii, 281, 781; "Statesman's Year Book," 1874, p. 229.

	£
Cost of Pensions, 1806 (before Wyndham's Act).	181,402
Ditto, 1806 (after Wyndham's Act)............	379,642
„ 1816	707,575
„ 1826	1,372,330
„ 1828	1,437,756
„ 1853	1,219,299
„ 1868	1,251,100
„ 1872	1,291,200

TABLE B.—SHOWING THE PERIODS OF SERVICE UNDER WYNDHAM'S ACT, 1806.

Clode's "Military Forces of the Crown," ii, 286.

	Infantry.	Cavalry.	Artillery.
	Years	Years	Years
First Period	7	10	12
Second „	7	7	5
Third „	7	7	5
Total	21	24	22

TABLE C.—SHOWING THE COMPARATIVE NUMBER OF RECRUITS WHO ENLISTED FOR UNLIMITED AND LIMITED SERVICES, 1809–28.

Marshall's "Military Miscellany," pp. 74, 75.

DUBLIN DISTRICT.

	Years.										
	1809.	1810.	1811.	1812.	1813.	1814.	1815.	1816.	1817.	1818.	1819.
Recruits Approved ..	1,103	1,224	1,480	2,624	2,531	1,303	2,759	2,027	989	1,090	2,029
Limited Service......	15	8	4	11	7	7	6	4	—	—	6

DUBLIN DISTRICT—*continued.*

	Years.									
	1820.	1821.	1822.	1823.	1824.	1825.	1826.	1827.	1828.	Total.
Recruits Approved ..	1,296	1,386	2,274	2,129	2,496	4,839	3,243	2,006	859	39,687
Limited Service......	7	—	3	4	2	6	3	1	1	95

LONDON DISTRICT.

	Years.												
	1817.	1818.	1819.	1820.	1821.	1822.	1823.	1824.	1825.	1826.	1827.	1828.	Total.
Recruits Approved....	696	695	454	710	832	458	825	1,411	2,541	1,789	1,036	559	12,006
Limited Service......	21	28	7	19	15	10	7	42	40	24	2	3	218

TABLE D.—SHOWING THE RATE OF DESERTION AT DIFFERENT PERIODS OF SERVICE.

"Blue Book of Royal Commission on Recruiting," 1867, p. 252.

Year.	Under 6 Months' Service.	Under 1 Year's Service.	Under 2 Years' Service.	3.	4.	5.	6.	7.	8.	9.	10.
1859..	2,820	1,220	1,251	141	281	289	101	57	33	20	13
1860..	2,272	1,034	1,319	1,040	165	284	321	102	50	41	30
1861..	1,172	829	938	731	539	107	220	226	83	40	36
1862..	477	316	577	533	429	469	110	149	194	60	26
1863..	529	312	385	548	512	459	395	85	147	176	71
1864..	706	494	400	260	372	349	337	362	54	133	180
1865..	791	581	549	279	210	336	319	340	325	66	184
Total	8,767	4,786	5,419	3,533	2,508	2,293	1,803	1,321	886	536	540

Year.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	Not Known	Total.
1859..	9	13	27	9	8	3	6	6	9	5	6	3	—	6,330
1860..	23	9	28	34	28	15	11	9	7	1	6	6	31	6,867
1861..	25	20	16	21	17	11	9	7	8	6	4	4	15	5,084
1862..	17	13	6	8	4	11	9	22	3	5	3	1	6	3,448
1863..	23	22	3	6	5	7	9	10	3	4	2	3	11	3,727
1864..	52	27	21	11	7	6	9	11	3	4	—	1	6	3,805
1865..	173	46	26	16	3	2	5	6	5	4	2	2	17	4,287
Total	322	150	127	105	72	55	58	71	38	29	23	20	86	33,548

TABLE E.—SHOWING THE COMPARATIVE MORTALITY OF SOLDIERS AND CIVILIANS, PER 1,000 LIVING, AT VARIOUS AGES.

"Army Medical Blue Book," 1872, p. 48.

	Under 20 Years of Age.	20—25	25—30	30—35	35—40	40 Years and upwards.
The Guards, Cavalry, Royal Artillery, and Infantry (exclusive of all Depôts), 1861-72, inclusive	2·84	5·53	6·43	12·24	17·54	24·03
Civil Male Population, England and Wales	7·41	8·42	9·21	10·23	11·63	13·55
Civil Population, Healthy Districts ..	5·83	7·30	7·93	8·36	9·00	9·86

Graphic Representation of the above Table.

A. Curve of mortality of male civil population, England and Wales.
B. Curve of mortality of male civil population, healthy districts.
C. Curve of mortality of the army, depôts excluded.

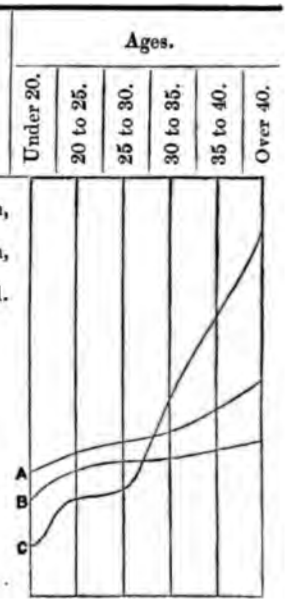

Table F.—Showing the Comparative Height of Soldiers at various times.

"Journal, R. U. S. Institution," vol. xviii., No. 76, p. 62; "Military Miscellany," p. 89.

Height.		About 1820.	1845.	1873.
Feet	Inches	Ratio per 1,000	Ratio per 1,000	Ratio per 1,000
5 5 5 5	1 2 3 4	—	105	864
5	5	4	—	—
5	6	114	473	433
5	7	180	204	111
5	8	252	111	62
5	9	184	74	15
5	10	128	16	12
5	11	73	17	3
6	0	40	—	—
6	1	15	—	—
6	2	7	—	—
6	3	1	—	—
6	4	1	—	—
6	5	1	—	—
		1,000	1,000	1,000

TABLE G.—SHOWING THE COMPARATIVE WEIGHT OF RECRUITS, 1871, 1872.

"Medical Blue Book," 1871 and 1872,

Proportion per 1,000 Examined.	Primary Inspections.	
	1871.	1872.
lbs. lbs.	Ratio per 1,000	Ratio per 1,000
Under 100	16·5	30·8
From 100 to 110	20·5	15·0
" 110 " 120	122·4	125·6
" 120 " 130	245·6	265·9
" 130 " 140	293·7	273·5
" 140 " 150	189·1	183·0
" 150 " 160	72·1	69·0
" 160 " 170	30·3	26·8
" 170 and upwards	9·8	10·4
	1000·0	1000·0

TABLE H.

Compiled from Marshall's "Military Miscellany," pp. 313, 315, 316, 350, 351.

	1831.	1832.	1833.	1834.	1835.	1836.	1837.	1838.
Ratio per 1,000 effective strength of non-commissioned and men tried for—								
Disobedience of orders	1·4	1·6	1·7	2·1	2·3	2·2	1·9	1·7
Insubordination	2·7	3·1	5·1	6·8	5·9	5·1	4·7	4·4
Disgraceful conduct	3·2	1·3	1·8	2·4	2·8	3·2	3·3	2·8
Drunkenness under arms	2·9	6·5	6·8	8·7	10·1	8·2	7·2	9·0
Habitual Drunkenness	5·5	9·2	10·5	10·8	14·2	12·8	13·2	15·9

TABLE I.

Compiled from "General Annual Returns," 1874, Tables 7, 28, 31, and "Report of Inspector-General of Military Prisons," 1874, p. 4.

	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.
Ratio per 1,000 average strength of non-commissioned officers and men tried for—									
Disobedience of orders.	2·1	1·4	1·0	1·3	1·8	1·1	1·4	1·4	—
Insubordination	6·0	5·8	5·7	7·9	9·6	9·1	9·0	8·4	—
Disgraceful conduct	3·4	3·3	2·7	3·9	4·0	4·0	3·7	3·8	—
Drunkenness under arms	8·6	6·7	7·3	8·5	9·4	7·9	7·4	6·4	—
Ratio per 1,000 dismissed with ignominy	—	—	—	—	13·2	8·9	5·3	8·8	10·7
Ratio per 1,000 fined for drunkenness	—	—	—	—	110·7	172·5	183·0	135·9	—

TABLE J.—SHOWING THE NUMBER OF COURTS-MARTIAL FOR HABITUAL DRUNKENNESS, 1865–1868.

" General Annual Returns," 1874, Table 28.

Years.	1865.	1866.	1867.	1868.
Number of courts-martial for habitual drunkenness	6,853	9,504	9,853	10,266

TABLE K.—SHOWING THE NUMBER OF ABLE-BODIED PAUPERS, 1859–1873.

" Statesman's Year Book," 1874, p. 243.

Years.	1859.	1860.	1861.	1862.	1863.	1864.	1865.
No.	137,418	136,761	150,526	167,646	253,499	186,750	170,136

Years.	1866.	1867.	1868.	1869.	1870.	1871.	1872.	1873.
No.	149,320	158,308	185,630	183,162	194,089	189,939	153,753	127,697

TABLE L.—SHOWING THE NUMBER OF RECRUITS AND DESERTERS FROM 1803 TO 1812.

Marshall's " Military Miscellany," pp. 76, 105.

Years.	By common Recruiting.	Additional Defence Act.	Volunteers from Militia.	Total.	Desertions.	Percentage of Deserters to Recruits.
1803	11,253	—	—	11,253	4,404	39·1
1804	9,430	1,658	—	11,088	5,468	49·3
1805	11,677	8,288	13,580	33,545	7,081	21·1
1806	11,875	5,834	2,968	20,677	5,748	27·7
1807	19,114	—	29,108	61,185	3,878	11·5[1]
1808	12,963				6,611	24·0
1809	11,720	—	23,885	44,700	4,901	17·0
1810	9,095				4,729	18·1
1811	11,472	—	11,453	22,925	5,026	23·6
1812	14,432	—	9,927	24,359	5,918	24·2

[1] This reduction was the effect of Wyndham's Act.

M.—COMPARATIVE TABLE OF PERCENTAGE OF DESERTERS TO RECRUITS AT THE BEGINNING OF THE CENTURY AND THE PRESENT TIME.

Year.	Percentage.	Year.	Percentage.	Year.	Percentage.	Year.	Percentage.
1803	39·1	1808	24·0	1863	25	1868	17
1804	49·3	1809	17·0	1864	18	1869	27
1805	21·1	1810	18·1	1865	24	1870	12
1806	27·7	1811	23·6	1866	23	1171	19
1807	11·5	1812	24·2	1867	17	1872	33

TABLE N.

Compiled from "General Annual Returns," 1874, Tables 18, 21, 23.

	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.	1871.	1872.
Ratio per 1,000 recruits who, absconded before attestation	27	23	19	25	33	20	23	14	16	14	16	19
Paid smart money...	71	60	64	81	90	79	82	66	69	68	82	86
Deserted after attestation	24	10	8	11	13	11	12	8	6	8	11	13
Ratio of soldiers per 1,000 average strength[1] who—												
Deserted	20·5	13	13·5	14·3	16·8	17·7	17·2	15·1	17·8	17·5	23·6	30·5
Purchased their discharge	10	7·2	8·2	7·7	10·8	11·8	13·3	10·3	9·8	8·2	10·9	14·7
Committed suicide[2] .	—	·27	·33	·32	·26	·37	·41	·46	·56	·37	·40	

[1] Officers included to admit of comparison with previous returns.
[2] "Journal of the Statistical Society," June, 1874, p. 188.

O.—COMPARATIVE TABLE OF DESERTION PER 1,000 AVERAGE STRENGTH AT DIFFERENT TIMES IN THE PRESENT CENTURY.

Year.	Ratio of Desertion.[1]	Year.	Ratio of Desertion.[2]	Year.	Ratio of Desertion.[3]
1805[4] ..	50·7	1831[7] ..	5·2	1865[8] ..	16·8
1806....	36·1	1832	4·1	1866	17·7
1807[5] ..	23·7	1833	7·7	1867	17·2
1808....	34·9	1834	7·5	1868	15·1
1809[6] ..	24·8	1835	7·3	1869	17·8
1810....	23·7	1836	5·8	1870	17·5
1811....	25·9	1837	9·5	1871[9] ..	23·6
1812....	29·8	1838	10·2	1872	30·5

[1] Clode ii, 436; Marshall's "Military Miscellany," p. 105.
[2] Marshall's "Military Miscellany," pp. 313, 315, 316, 350 and 351.
[3] "General Annual Returns," Tables 7 and 21.
[4] Short Service, Pitt's Act. [5] Long Service, Wyndham's Act.
[6] Life Service, Castlereagh's Act.
[7] Life Service. [8] Long Service. [9] Short Service.

GRAPHIC REPRESENTATION OF THE RATE OF SUICIDE, DESERTION, AN PURCHASE OF DISCHARGE, FROM 1861 TO 1872.

A. Rate of Suicide per 100,000 men ....
B. Rate of Desertion per 1,000 men ....
C. Rate of Purchase of Discharge per 1,000 men

Note on Suicide.—The service ammunition was removed from the men's pouches and placed in the regimental magazines on the 7th Sept., 1869.

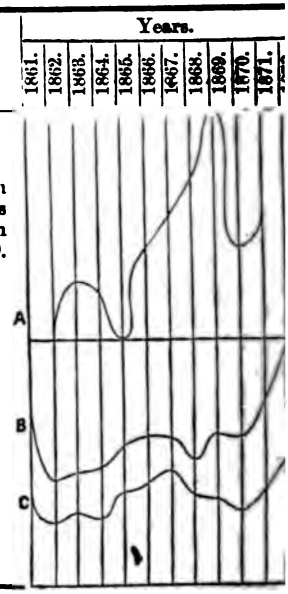

TABLE P.—SHOWING THE NUMBER OF FOREIGN MERCENARIES IN T ENGLISH ARMY, 1804–13.

Clode's "Military Forces of the Crown," ii. 436.

	Year.				
	1804.	1805.	1806.	1807.	1808.
English troops	133,554	139,581	159,076	163,641	189,21
Foreigners	17,039	22,375	26,043	35,816	37,21

	Year.				
	1809.	1810.	1811.	1812.	1813.
English troops	197,230	199,062	194,051	198,004	207,0
Foreigners	36,947	38,390	40,543	45,881	53,72

TOWN LABOURER.

	Ireland.	Mr. Purday's averages.			Town Labourer.			
...ire.								
Single.	Average.	England.	Scotland.	Ireland.	London.	Manchester and Birmingham.	Edinburgh.	Glasgow and Liverpool.
£ s.	£ s.	£ s.	£ s.	£ s.	£		£ s.	
19 10	18 9	—	—	—	49	—	39 3	—
—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—
2 12	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—
0 18	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—
12 2	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—
35 2	18 9	30 0	33 14	18 9	49	—	39 3	—
s. d.	s. d.	s. d.	s. d.	s. d.	s. d.		s. d.	
13 6	7 1¼	11 6¼	12 11½	7 1½	19 0	—	15 1	—

d by the number of days in the year that he is usually out of work.

TABLE R.—SCHEME FOR A CONSCRIPT HOME ARMY.

	Year.								
	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.
First Line, under Arms—									
Regulars	100,000	90,000	80,000	50,000	—	—	—	—	—
Conscripts of 20 years	—	10,000	20,000	50,000	100,000	100,000	100,000	100,000	100,000
Total..........	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
First Reserve—									
Conscripts of 21 years	—	—	10,000	20,000	50,000	100,000	100,000	100,000	100,000
Conscripts of 22 years	—	—	—	10,000	20,000	50,000	100,000	100,000	100,000
Militia and Yeomanry	130,000	130,000	130,000	130,000	130,000	50,000	—	—	—
Total..........	130,000	130,000	140,000	160,000	200,000	200,000	200,000	200,000	200,000
Second Reserve—									
Conscripts of 23 years	—	—	—	—	10,000	20,000	50,000	100,000	100,000
Conscripts of 24 years	—	—	—	—	—	10,000	20,000	50,000	100,000
Total..........	—	—	—	—	10,000	30,000	70,000	150,000	200,000

N.B.—With the exception of the one year's service in the First Line, this Table is merely suggestive.

LECTURE.

Wednesday, April 7, 1875.

General Sir WILLIAM J. CODRINGTON, G.C.B., Vice-President, in the Chair.

ON THE BEST PRACTICABLE METHOD OF ENSURING EFFICIENCY IN THE ARMY, AND FOR OBTAINING AN EFFECTIVE AND RELIABLE RESERVE, HAVING REGARD TO THE EXISTING FEELING IN THE COUNTRY ON THE SUBJECT.

By Major-General Sir Edward C. Warde, K.C.B., R.A.

"All nations are in confident expectation of war, and all are alike arming and "preparing to meet and defend themselves against its evils. It behoves England, "like other nations, to prepare and provide for her military security."—"Considera-"tions on National Defence." Addressed to the people of England, by General Sir Robert Gardiner, G.C.B. Third edition, 1860.

There are three points connected with the subject of my lecture which present themselves specially for consideration :—

First. Is the nation satisfied with the Army which it at present possesses ?

Second. Assuming from all that has passed in Parliament, here and elsewhere, that it is not, what would be the best practicable mode of obtaining such an army as would satisfy the nation ?

Third. Short service enlistment and general conscription having been proposed as the best means of obtaining such an army, is that method practicable ? Will the country accept it, and is the Government prepared to propose that it should do so ?

Assuming, for the sake of argument only, that this may be the case, would that method obtain an army such as the nation has, until within the last few years, hitherto possessed ?—an army described by the Duke of Wellington as one with which he could go anywhere and do anything—or which nearly half a century later won the battles of the Alma and of Inkermann, and stamped out the Indian Mutiny ?

If not, what alternative system which the nation will accept, and the Government would not hesitate to adopt, is the best calculated to produce the desired result ?

It is in the hope that some progress may be made in the solution of this difficulty by so doing, that I propose to read the paper before me, which was written in August, 1874, and may probably be recognized by some now present, who read it in the autumn or early winter of last year.

I mention this fact, in order that I may not lie under the possible imputation of presenting to you a *réchauffé* of those views and opinions which have been discussed in Parliament this year, given utterance to in post-prandial speeches at Mansion House and other banquets, and so many of which have been set forth in leading articles and letters in the public press during the last six months.

One of the chief reasons, however, for my purposing to read this paper arose from the fact of so many of such views and opinions coinciding almost identically with those which are therein set forth.

I do not for one moment intend to assert with regard to them—what the talented author of that very able production, the Prize Essay on recruiting, does of his views and opinions therein expressed—that they are the only possible ones by which the difficulty can be overcome. I make them known, in order that other minds may either accept or reject, or possibly amend and improve them. I desire also to take this opportunity of expressing my acknowledgments to the Council for their kind courtesy in placing a day at my disposal for this purpose.

"The best practicable method for ensuring the efficiency in the Army, and for obtaining an effective and reliable Reserve, having regard to the existing feeling in the country on the subject."

" To discard an old servant like an old cloak, is not economy, but the " worst species of extravagance; it is the surest method known to " obtain bad servants, to engender bad feelings, and to earn a bad " reputation."

Before entering on a consideration of this subject, it is necessary to observe that England stands alone throughout the world in her relations with regard to it, and that a system which might be admirably well adapted to the great military nations of the continent, and be found successful in its operations, would be altogether alien to her views, and unsuited to her requirements.

Duties of Army during Peace.

It must be borne in mind, that England, instead of having her army concentrated at home, as the great military nations of Europe have, is obliged to provide for the maintenance of a sufficient force in her Indian Empire, as well as to consider the protection of her widely-scattered colonial possessions, to all of which (although recent policy has for the time almost denuded them of her military forces), she must be prepared to send efficient Imperial assistance, both by sea and land, in the event of such aid being required.

Cost of Transport.

This necessity must always greatly affect the cost of maintaining our Army, and the large drafts which we are compelled to send out

annually to keep our regiments in India effective, and the heavy expense which is thus incurred under the old system of long service enlistment, would show to how great an extent that expenditure must be increased if the short term of enlistment is continued, and becomes the rule of the Service.

Again, it is an undisputed fact that men going to a climate totally different to their own, take some considerable time to become acclimatized, that time, up to a certain age, varying as a rule in an inverse ratio to their age at starting.

According to our old peculiar system, the average age of men in a regiment going abroad would be that at which they would be least liable to suffer from the effects of climate. Under the Continental system, which we have for the present adopted, that average is likely to be reduced to that at which men are least able to combat a trying climate. In fact, at present, no sooner is a man's physique fully developed, than he is drafted from the ranks, and his place supplied by a growing lad, whose strength will be first exposed to an Indian sun at the very time of his life when he can least resist it.

It is perfectly well known, and may be regarded as a recorded fact, that of the recruits sent to the Crimea, and to India during the mutiny, a *very* large proportion never did any duty in the ranks at all, but sickened soon after their arrival, went to hospital, and either died there, or were sent home as utterly useless, and at an enormous loss to the country. Had these recruits been a little older, and their physique more fully developed, the country would have got some return for its money in the good work they would have done, instead of its having to expend more in sending others out to do what those had failed in doing.

Description of Service.

The same code of military laws and terms of enlistment in the Army could scarcely be successfully co-existent in two nations where compulsory service and voluntary engagement are the terms on which men serve the State as soldiers in their respective armies.

The Army of England being necessarily on a very small scale numerically as compared with that of any of the great Continental Powers, is another reason why the same terms of enlistment in its ranks would not be applicable, with any chance or prospect of success.

It will be necessary to adopt some system which will not only ensure the possession of an army as *good* as any other military nation, but one that, from superior training and other causes, must be infinitely better, otherwise with what hope or prospect of success could the Army of England ever engage in hostilities at all?

It may possibly be imagined that this is taking a view of the subject that is never likely to be realized; but we have only to look back upon the past, and those glorious achievements of our Army which it records, to feel assured that there is no reason to doubt that what has been done in days gone by may be repeated in those that are to come.

Taking these circumstances into account, and bearing also in mind that anything like conscription or compulsory service is altogether

alien to the views of England at this period, it is proposed, in dealing with this subject, to assume that service with the Army will be altogether voluntary in the future, as it has been in the past.

Modes of Enlistment.—Enlistment for General Service.

One great obstacle to obtaining recruits of late years has been that change in the mode of recruiting which has done away with regiments and corps enlisting entirely for themselves, and enlisting them without any reference to their own predilections for general service, and also the liability which, in accordance with present regulations, they incur, by being drafted from one corps into another against their will—a regulation which not only throws a very serious obstacle in the way of obtaining recruits, but is prolific of desertion to a very great extent.

Men who might be willing to enlist, if they were allowed to choose the regiments in which they would have to serve, will frequently decline to do so under any other circumstances.

In confirmation of this assertion I beg to read an extract from a letter which I received last week from Colonel Kent, commanding the 77th Regiment, which I think will be admitted to be as striking an illustration as could possibly be given of the loss which has accrued to the Service by this abolition of regimental recruiting, and which goes a long way also to prove that voluntary enlistment for the Army, if properly conducted and encouraged by higher inducements, which need not be ruinous to the country, would answer all our requirements.

" You are most welcome to make use of what I told you about our " linked militia regiment, 'the Royal London,' and I sincerely trust " that it may do some good, because nothing can be worse than our " present system of preventing men enlisting for particular regiments " if they like.

" The Officer commanding the East London told me himself, at the " completion of their last year's training, that he would give me 100 " men if I could take them for the 77th, but that they would *not* " enlist for the brigade; and I am sure that he did not exaggerate, " because formerly I used to get a heap of men from that regiment and " the Royal East Middlesex Militia—*such nice smart men*—that any " Commanding Officer might be proud of, and now I get not one: " comment upon this is needless."

And again, men who have enlisted and become attached to the corps in which they are serving, have in many well-recorded instances resented a compulsory removal from such corps, by deserting at the first opportunity after their removal.

Enlistment for particular Regiments.

It is essentially necessary, when framing laws for the future enlistment of men into the Army, to guard against any clause that might tend to induce them to desert after enlistment, and it is therefore suggested that the localisation scheme recently introduced should for the future be rigidly adhered to, with the exception of that clause which enlists men for the brigade instead of for each regiment.

By this scheme, regiments would, as of old, enlist entirely for them-

selves, which would ensure to men enlisting, a knowledge of the regiments for which they were offering themselves, and would further carry out the advantages which the localisation scheme was intended to introduce, viz., an interest throughout all ranks and classes in each sub-district in the regiments belonging to it, an intimate association, and, so far as is practicable, a personal knowledge of each other, between the regiments, the militia, and the volunteer corps, that are by these regulations to be permanently associated with them; and to rouse such a feeling of attachment to each regiment throughout its own district as to ensure a continuous flow of recruits into its ranks in any numbers that might be required; it being also distinctly understood that men could not be drafted from the corps in which they had engaged to serve against their will, except under the most urgent necessities of the Service. This state of things could scarcely ever exist; as experience has shown that, whenever volunteers are wanted to complete regiments ordered on active service, the supply has invariably been greater than the demand.

These regulations need not prevent recruiting parties being sent out of their own districts to different parts of the country when, as may sometimes occur, they are unable to raise the large number of recruits that are often required at short notice to bring up a regiment to its increased strength for ordinary colonial service.

There may be no reason why recruiting parties enlisting for general service should not take an interest in their duty: still it is more than possible that, not knowing what may become of the men they enlist, and getting no extra credit for unusual exertions, they will not take that pride in their work, which would be only natural if they knew that the result would bring credit to themselves from their own regimental head-quarters; whereas it stands to reason that, where regiments enlist their own men, they will naturally, and in accordance with the rules of human nature, take a special interest in getting the best men that they can find, and every officer, non-commissioned officer, and man, engaged in such duty, will take a pride in obtaining them.

One great advantage of these regulations would be the saving of the considerable expenditure now required for the maintenance of the existing head-quarter recruiting staff and its various branches throughout the country.

Conditions of Service.

It is proposed to state, as succinctly as a clear apprehension of the subject will allow, the relative advantages and disadvantages of the different modes of enlistment under which men are now invited to the Standard, and which may be classed under the heads of Long and Short Service.

Short Service.

The advantages which it is proposed to obtain by the introduction of short service are:—first, to establish an Army Reserve, as the result of the number of men that would, under this system of en-

listment, be drafted annually into it from the ranks of the regular Army.

It is extremely doubtful—to many, more than doubtful—whether the inducements at present held out by this system would have the desired effect of obtaining for the country a *reliable* army of reserve, of such strength as to be of any real value; because the small allowance of four pence a day, which would cease the moment a man completes his service in the Reserve, is no sufficient inducement to keep him in the country, coupled as it is with the great disadvantage of rendering him liable, at any time, to be called away from his civil employment in order to revert to his duty with the colours, and thus, for an uncertain period, have his connection severed with whatever branch of trade he might have established himself in, without being able to look forward to any ultimate substantial compensation for such a loss.

On the other hand, this allowance, paid as it is in lump sums, is a bonus to tempt men out of the Army, for, in other words, it says, if you are sick of the Army, go into the Reserve, where you will soon be given enough money to assist you in emigrating, and in thus placing yourself beyond the reach of your obligations!

In this way how *could* the Reserve ever become a reliable force?

Again, after the first six years of a soldier's life, he has got over the drudgery of his recruit drills, but *not* served long enough to appreciate his soldier's life; he is for the present time sick of soldiering, and willingly takes advantage of the Reserve to get quit of it, and goes back to his home full of grumbling and discontent; whereas if not allowed to join the Reserve for a longer period, the drudgery of his recruit days has become effaced by the after-comforts and advantages of his soldier's life, which he has since learnt to value, and he eventually joins the Reserve with very different feelings.

Many men enlist because they are too unsteady for civil life; those good for anything become steadied during their few years' service, have had time to look about them, find good openings in civil life, and are tempted away directly their time is up; and only those who are good for nothing remain, the country being unable to dispense with their services.

Another supposed advantage of short service is, that such mode of enlistment would be more attractive, and would be the means of inducing a better class of men to join the Service; but, in so far as it has as yet been tried, it has utterly failed in producing the expected and hoped for result.

Among the disadvantages of short service would be the extreme difficulty of obtaining reliable and trustworthy non-commissioned officers; because, as already shown, many of the best men, after their careful training would, at the end of their short service, gladly accept good openings in civil employment; whereas if they had not this opportunity, they would settle down to their soldier's life, and eventually become good non-commissioned officers, without which it would be impossible either to form or to maintain a real Army.

Again, it takes some time before officers can learn the characters of

their men, and some time before men can learn to have confidence in their officers.

In the large armies of the Continent some of the above considerations may not be of so much importance; but in our own, which must always be much smaller, it becomes necessary to develop its every quality to its fullest extent. Experience, perfect training, mutual reliance, will render a little army far superior to a numerically large one without these qualities; but the possibility of being able to develop them under the Short Service System is open to grave doubt; and it behoves, therefore, those who are charged with legislative powers, to ponder well before depriving our Army of those qualities which constitute the mainspring of its strength; which, and which alone, have enabled it to meet and to overcome almost any amount of odds that have from time to time been arrayed against it: take, for example, the result of that glorious struggle which took place on the heights of Inkermann.

"Esprit de Corps."

By the introduction of short service into the Army, we should deprive it at once, and for ever, of one of the chief elements of its past successes, viz.:—"Esprit de Corps," and of those ties, invaluable ties, which have hitherto bound officers and men together in bonds of sympathy, of mutual affection and regard, and which have given them such implicit confidence in themselves and in each other, as have resulted in those glorious victories and bright achievements which have made England respected, and her Army celebrated throughout the world.

This in itself should make those who are entrusted with the destinies of England pause and consider this subject long and anxiously before introducing, or it must now be said before perpetuating a system, which there can be no hesitation in saying would, for the abovementioned reason, be condemned by nine-tenths of all ranks of those in the British Army who have known what the true value of those feelings is, by having tested it whilst on active service in the field.

Long Service.

The chief advantage to be *retained* by a system of long service enlistment has been shown in the preceding paragraphs, and need not therefore be repeated; but, in addition, it is believed that under certain conditions that will hereafter be detailed, it would secure a better class of recruits; the old prestige and high character which, by its deeds, the British Army has won for itself throughout the world, would be preserved, and it would not become necessary to sacrifice the Army, in the hope by so doing of obtaining what would at best prove to be a doubtful and unreliable Reserve.

Attraction to the Ranks.

Where either conscription or generally compulsory service is the national law, there can never be any difficulty in obtaining any number of men for service in the Army that may be required, and the various

classes of society will be called upon to furnish their relative quota to any extent that may be considered necessary. But where, on the other hand, engagements to serve with the colours are, as in this country, purely voluntary, a system which has hitherto been one of our proudest traditions, and the envy and admiration of the world, such temptations must be held out as will induce men to enter the Service; and unless the terms which are offered are of such a character as will be in some degree superior to those which the class of men who enlist generally in our Army can obtain for themselves in the various occupations of civil life, one of two results must necessarily follow: either the requisite number of men will not be forthcoming, and the required complement will not be maintained, or it will be composed of the refuse of the people, both physically and morally, who will be unable to obtain any other employment

It becomes necessary, then, to consider what those terms should be which will attract men in sufficient numbers to the standard; and of such a class as will be calculated to prove a credit to the Service, and to maintain, whenever a time of trial comes, its character and prestige —a result which it is hoped that the proposals made in the subsequent pages of this paper may be found capable of obtaining.

It will probably be desirable, in enumerating the terms above referred to, that they should be classed under seven different heads, as under:—

1st. The Rate of Pay to be received whilst serving.
2nd. Duration of engagement.
3rd. Prospects of advancement in the Service.
4th. Indulgences to be accorded to well-behaved men.
5th. Gratuities to be granted to widows and orphans.
6th. Pensions to be received on completion of engagement.
7th. Prospects of after employment as pensioners.

1st. The Rate of Pay to be received whilst serving.—In treating of this portion of the subject it is not considered necessary to make any suggestions with regard to the daily rate of pay at present received by the rank and file, as it is believed that the advantages which are held out to them, and which will be hereinafter enumerated, coupled with the increased pay and pensions which it is considered that the higher class of non-commissioned officers should receive, would hold out sufficient inducements to them to ensure an ample supply of recruits of such a class as it is desirable to obtain.

Pay of Non-Commissioned Officers.

The case, however, is very different as regards the two senior ranks of non-commissioned officers, the staff sergeants and sergeants of the Army, and when it is known that the lowest class of warrant officers[1] in the Royal Navy, of which there are three, has a higher rate of pay than the best paid staff sergeant in the Army; that the first class warrant officer has £51 11*s*. 3*d*. more than any staff sergeant of in-

[1] The pay of a first class warrant officer is £120 a-year
" second " " £100 "
" third " " £90 "

fantry; and, as is shown in the annexed tabular statement, that the rate of wages that can be earned by different classes of unskilled labourers throughout the country, is, after all necessary deductions, in some cases as good as and even better than that of staff sergeants, it surely must be conceded that an increase in the pay of these two grades of non-commissioned officers in the Army is required.

Rank.	Daily pay.	Stoppages.				Residue.
		Food and fuel.	Clothing.	Lodging.	Total.	
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Sergeant-major	*3 3	0 6	0 9	—	1 3	2 0
Staff-sergeant	*2 5	0 6	0 5	—	0 11	1 6
Sergeant	*1 11	0 6	0 5	—	0 11	1 0
Dock labourer..........	5 0	2 0	0 6	1 0	3 6	1 6

Wages have risen since 1870 at the rate of 48 per cent. in Northumberland; Durham, 50 per cent.; at Verviers, 20 per cent; Ghent, 60 per cent.; in Silesia, 60 per cent. Labourers in America earn from 24s. to 36s. a week. Cost of living, 14s. a week.

Colliers' Wages.

	s.	d.	
"Hewers"	48	9	per week.
"Timbermen".	53	5	"
"Landers"	36	9	"
"Haulers"	31	6	"
"Labourers"..	24	0	"

It is scarcely possible to estimate too highly the value of these two classes of non-commissioned officers. They are the connecting links between the officers and men, and it would be impossible to maintain a high state of efficiency and discipline without having in these positions men of high moral character, and rather more than average ability.

If therefore the object sought, of first obtaining such men, and, secondly, of inducing them to remain in the Service when secured, is to be attained, it seems only reasonable that higher inducements should be held out to them; and it is believed that a higher rate of pay whilst serving, combined with the advantages of warrant rank, and a correspondingly increased rate of pension on discharge, would tend very materially to produce the desired result.

It is further suggested that the existing regulations, by which a corporal when promoted to the rank of sergeant loses any good conduct pay that he may be receiving at the time of his promotion, should be considered and amended; because, as these regulations now stand, they tell unequally upon men so promoted; and the men whose

* These rates are Infantry pay.

steadiness and general good conduct have rendered them entitled to this additional amount of pay, lose the advantage which such good conduct has obtained for them.

In illustration of the above, it may be stated that a corporal promoted to the rank of sergeant, and being at the time of his promotion in possession of four good-conduct badges, would benefit by four-pence a day, whereas a corporal promoted, in possession of one good-conduct badge, would benefit by seven-pence a day.

It is suggested, therefore, that the recipient of good-conduct pay should continue to receive throughout his service, or until he might obtain warrant rank as a regimental staff sergeant, the amount of any good-conduct pay of which he was in receipt at the time of his promotion to the rank of sergeant—as this would tend to increase his daily pay, and hold out an additional inducement to young soldiers to conduct themselves steadily and well.

2nd. *Duration of Engagement.*—It is proposed that men should, in accordance with the views set forth in this paper, enlist for nine years with the colours and three in the Reserve, with the option of prolonging their engagements either with the colours or in the Reserve, on terms which will be stated in detail when the latter portion of the subject—the formation of the Reserve—is dealt with.

Grant of Commissions.

3rd. *Prospects of Advancement in the Service.*—It is more than doubtful whether the granting of commissions to non-commissioned officers can be considered advantageous, and it is fully believed that in the great majority of cases it is rather ruinous than otherwise.

This is more certainly the case now than when purchase existed in the Army, and a man could look forward to the hope of selling his commission, and thus realizing a sum of money for himself, if a bachelor, or for his wife or family, if married.

Under existing circumstances, a man who has perhaps led a happy and contented life, and whose pay has been sufficient to keep both himself and his family in a state of comfortable independence, and who has friends around him with whom he associates in free and social intercourse, finds himself suddenly raised to a rank above that in the social scale to which either he or his family have ever been accustomed, and in accordance with the necessary rules of the Service, cut off from his former friends and companions, and called upon to maintain, not only in his own person, but as regards the outward appearance of his family as well, the position of "an officer and a "gentleman."

To enable him to fulfil this latter condition, what means are placed at his disposal? He receives, as a lieutenant, a trifle more in amount of daily pay than is earned by a dock labourer of industrious habits in London, or any of our great commercial ports!

Can it then be considered as either an act of kindness, or a just or adequate reward for high intelligence, or long, faithful, or distinguished service, to place a man in such a position?

It is not proposed, in making the above observations, to close the

door entirely to this species of reward, or to abolish altogether such an object of ambition to the soldier as the elevation to commissioned rank; because there are doubtless cases in which men who have enlisted in the ranks and distinguished themselves, either before an enemy in the field or by long and meritorious service, may have private means independent of their military pay, or may have friends who might be both able and willing to assist them, or who might from peculiar circumstances be better fitted for such a total change in the social scale than the generality of the class to which they belong. To such men it is most desirable that such an honourable object of ambition should be held out. But these men will always be exceptions to a general rule; and it is equally desirable therefore to adopt some other mode of advancing and rewarding deserving non-commissioned officers, that shall not be open to the objections above enumerated; and with this object in view it is suggested that the advantages of warrant rank should be restored to the Royal Artillery, that it should be extended in that arm of the Service, and introduced into the rest of the Army. It is believed that it would be considered a great boon to the Service at large, and that it would hold out a very strong inducement to good men to enter it, and to good and trustworthy non-commissioned officers to remain in it, if warrant rank, of which they were some years since deprived, was restored to the master gunners of Royal Artillery; if it was extended to the brigade staff-sergeants of that arm of the Service, and accorded to the regimental staff-sergeants of the rest of the Army. It may appear at first sight that this is rather a wholesale recommendation of advancement for the non-commissioned officers of our Army; but when it is considered than an army without really good and reliable non-commissioned officers can never be good for much, or in any way to be depended on, and when we know, as from unhappy experience we now do, that, with a very few and rare exceptions, all non-commissioned officers quit the Service the moment they have it in their power to do so, and almost invariably find immediate and lucrative employment in civil situations, it becomes necessary—absolutely and essentially necessary—to hold out to them such prospect of advancement and remuneration as will induce them to feel that it will be more to their own advantage to remain and serve their full time for pension in the ranks, than to leave at the expiration of their first term of engagement, and seek for employment in civil situations.

Punishment of Non-Commissioned Officers.

It may be well to advert under this head to the laws which regulate the punishment of non-commissioned officers, and to offer a suggestion for their modification, because, although it is not within the scope of a paper on this subject to enter into any detailed provision for their alteration, it is considered competent to the writer of it to offer suggestions, which will of course be left for the consideration of those within whose province it lies to give orders and to issue from time to time amended laws and regulations.

As the law at present stands, there are certain offences for which non-commissioned officers must of necessity be brought to trial by

court-martial, and for all offences, if convicted, they must also, of necessity, be sentenced to reduction to the ranks. This may, and frequently does operate with great hardship upon excellent, good, men, who for one fault accidentally committed towards the close of a period of service which may up to that time have been characterised by systematic and unvarying good conduct, are suddenly disgraced and ruined, without any hope or prospect of recovery.

It would seem therefore desirable to accord to commanding officers increased discretionary power in bringing men to trial by court-martial, and so to amend the laws which now exist with regard to crimes and punishments, as will enable courts-martial to award some minor punishments which would not utterly ruin a man whose period of service might be drawing to a close, or as would enable a non-commissioned officer of shorter service to recover the position he had lost.

There can be no doubt whatever that strict and even stringent laws are necessary for the maintenance of discipline in an Army, but there can be as little doubt that human nature is subject to infirmity, and that those whose duty it is to frame such laws as are above referred to, would do well to bear this in mind; and it is firmly believed that a due consideration for these unavoidable weaknesses of humanity, in drawing up such regulations, would not only tend to strengthen and improve discipline in the ranks, rather than to impair or weaken it, but would also assist materially the object for which this paper is written, by inducing good and respectable men to enter them.

4th. *Indulgences to be accorded to well-behaved Men.*—This is a point that may very fairly be considered open to some relaxation as regards existing regulations.

But as it must, in a great measure at all events, be left in the hands of commanding officers, it may suffice to say, that as much indulgence should be granted to good men as is consistent with strict discipline.

This point is considered an essential one, when the subject under consideration is, as in the present instance, how best to attract men and induce them to devote their lives to the military service of their country; a long experience having proved that it is far easier to lead men than to drive them, and that the commanding officer who proves to those under him that he identifies himself with them, and takes a real interest in all those minutiæ of detail which affect their comfort and their happiness, will get ten times as much work—and willing work too—out of them, as the one who stands aloof from them, and regards them as mere machines, simply to do the work required of them.

5th. *Gratuities to be granted to Widows and Orphans.*—Granting gratuities to widows or orphans of soldiers who might die while serving, would be an additional encouragement to men to continue in the Service.

This plan has been found to produce most beneficial results in our Metropolitan Police Force, and might be extended, on a modified scale, to our Military Service, without involving any serious augmentation to the Estimates, if calculated in the following manner:—Confine the

boon to men who, at the time of their death, might be in receipt of good-conduct pay, and then hand over to the widows or orphans the difference, for two years, between the pay of the deceased and the recruit that takes his place. At present a man's death is, in one sense, a gain to the country, inasmuch as the recruit who takes his place gets less pay than *he* would have received had he continued to live; whereas, by handing this difference over to the widows or orphans, the country does *not* gain what, on the whole, would be but a paltry sum in the Estimates, but which *would* be a valuable boon to the objects of the charity. The married soldier would thus feel that his continued good conduct would prove advantageous to his family, even after his death; a great cause of restlessness would be removed; he would be more inclined to continue in the ranks, instead of being constantly on the look out for some civil employment that might enable him to make the above provisions; and further, it would be an additional inducement to men to behave well, knowing, as they would do, that the loss of a good-conduct badge would entail, not only a temporary loss of a penny a-day, but an eventual loss to their families.

The gratuities that would be awarded, according to the above-mentioned proposal, would vary in sums of from £3 to £15.

The following scale gives the amount of these gratuities:—

The widow or orphans of a man in—

						£	s.	d.
1st	period	of service	and	1	G.C.B.	3	0	10
"	"	"		2	"	6	1	8
2nd	"	"		1	"	6	1	8
"	"	"		2	"	9	2	6
"	"	"		3	"	12	3	4
"	"	"		4	"	15	4	2

6th. Pensions to be received on completion of Engagement.—This subject will also be dealt with under the head of "Formation of Reserve."

7th. Prospects of after Employment as Pensioners.—All pensioners should be registered for employment in the Public Departments, and should have a preference for employment over civil competitors in such positions as they may have been registered as competent to undertake.

Formation of Reserve.

The difficulty which presents itself with reference to this portion of the subject, is the mode by which a Reserve can be obtained in connection with long service, that shall be of sufficient numerical strength to justify its adoption; but it is believed that this difficulty can be overcome in the following manner, viz.:—

Length of Service.

That men shall be enlisted for nine years with the colours, and three in the militia, with the option of continuing to serve in the militia for six years, at the expiration of which time they should become

entitled to a pension of sixpence a-day, in addition to any good conduct-pay to which they might have become entitled during their nine years' service with the colours, and with the further option of continuing to serve for twelve years with the militia; at the expiration of which time they should become entitled to a pension of one shilling a-day, in addition, as above, to any good-conduct pay to which they might have become entitled during their service with the colours.

Any soldier who should re-engage to continue serving with the colours, should, at the expiration of fifteen years' service, and three in the militia, become entitled to a pension of a shilling a-day, in addition as above to good-conduct pay; and, should he still continue to serve, become entitled, at the expiration of twenty-one years' service, and three in the militia, to a pension of one shilling and sixpence a-day, and good-conduct pay.

The above is shown below in a tabular form.

Scale of Pensions.

		s.	d.
Pensions after	9 years with colours, and 6 in the militia	0	6
,,	9 ,, 12 ,,	1	0
,,	15 years with the colours, and three in the militia	1	0
,,	21 years with the colours, and 3 in militia	1	6

The above pensions to be in addition to any good-conduct pay obtained during service with the colours.

The pensions of non-commissioned officers should be in proportion to their rates of pay on discharge.

Strength of Reserve.

Should the Reserve that would be thus formed, not be considered sufficient, the present strength of the militia might be increased by recruiting.

Cost of Reserve.

If the above increase to the militia be found too costly, it might be modified in the following manner:—The militia recruits to be called out, as at present, for forty-one days. The trained men and old soldiers to be divided into two classes. The second class to consist of soldiers who had not completed three, and men who had not completed five trainings, to be called out for twenty-seven days.

The first class to consist of militiamen of over five, and soldiers of over three trainings, and to join head-quarters only for the last fourteen days of the annual training.

Men who had served with the colours for fifteen and twenty-one years respectively to belong to the first class.

This arrangement need entail little or no extra staff, but merely increase the strength of existing battalions; but some of its great advantages would be, that such Reserve, whatever its numerical strength, would be substantial and reliable; the old soldiers would be

kept more efficient by being drilled with large battalions, instead as at present in small ones; the vast advantage that would accrue to the militia, and the great facility that would be given to its instruction during the annual periods of training, from having such an admixture of thoroughly trained and well-affected soldiers in its ranks; the fact of having throughout the country men returning to their native places in a happy and contented frame of mind on leaving the Army, instead of doing so in a discontented and disgusted state; and, above all, the priceless value of retaining an active army of thorough and real soldiers, imbued with the feelings that have already been described under the head of "Advantages of Long Service," instead of sacrificing such an army, and substituting for it an array of armed men, scarcely knowing their officers or being known by them, in order to obtain the very doubtful advantage of having a Reserve of greater numerical strength, which might or might not be forthcoming when required. And again, when it should be found necessary to call the old soldiers back to the colours, the militia would, under this system, merely revert to what it was before, only in a far more efficient state.[1]

"The great crisis of the world is nearer than some may suppose, and "we ought to be active in preparing to take our share in that crisis, "which honour and self-preservation may demand."—*Disraeli*, 1874.

Concluding Remarks.

Having now enumerated the various points which it is considered would have the desired effect of attracting men to the standard, and inducing a sufficient number of the respectable portion of the labouring and artizan population to enter and to make a profession of the Service, and thereby to solve the existing problem of enlistment for the Army, as well as to obtain a sufficient and reliable Reserve, there remains but one point further to touch upon with reference to this subject, and that, the relative cost of the two systems, viz., that which is now in operation, and the one which is sketched for consideration in the pages of this paper.

There can be no doubt that the latter would be the more expensive of the two, but not to such an extent as should induce the Government of this great and wealthy nation to hesitate a moment in adopting it, provided it is considered the best calculated to obtain the desired result.

It has been said, and, doubtless, with truth, that "Economy is the "life of the Army;" but the question naturally arises, what is economy? Is it economy to spend millions annually on the Army

[1] It will doubtless be objected to this mode of obtaining a Reserve, that it would take far too long a time to come into operation, but that difficulty may be very easily overcome.

Give every man now serving, all those who have become pensioners within the last two years, and all men of good character who have taken their discharges at the expiration of their first period of engagement, also within the last two years, the option of accepting its conditions. You would thus doubtless obtain a Reserve at once, of considerable force, which would increase annually, and the flow of men into which would be unceasing and continuous.

Estimates without getting the value of your money? that is, in this case, without getting what is wanted, a contented and effective Army, supplemented by a reliable and efficient Reserve. Would it not be far more like true and real economy to expend one or two millions more, and to succeed in realizing the object for which such sum is expended, by having an Army of such power, and so organized, as to secure the nation which it is paid to serve, against insult or contumely abroad, and to enable those out of whose pockets the money so expended comes, to rest in perfect and peaceful security at home.

"The Army is the annual premium of insurance against foreign invasion and the dismemberment of territory. You cannot diminish the premium without diminishing at the same time the safeguards of the country. Forgetfulness of this has cost us two of our most patriotic provinces and five milliards."—*Committee of Organisation of the French Army*, 1874.

Do not the number of insurance offices existing prove, beyond a shadow of doubt, the great extent to which private property is insured by those individuals by whom it is possessed? Are not the risks incurred by fire or by the perils of the deep guarded against most carefully in a very large majority of instances? What are these dangers, what these risks, compared to the utter destruction that would swoop down upon these very properties and possessions, in the event of a successful invasion of this hitherto peaceful and happy land?

It rests, then, with the Government to consider and decide whether they will look this question firmly and fully in the face, and tell the country whose affairs they have been chosen and appointed to administer, frankly and truthfully, that its defensive forces are not in a condition to answer the purpose for which they are maintained; and that if it wishes to uphold its honour and prestige amongst the great nations of the earth, it must adopt such measures as they are prepared to propose, and it must do in this case what daily experience proves must be done in every transaction of life—it must pay for them.

Nations, like individuals, must pay the market price for what they want. If a man wants a good weight-carrying hunter, he cannot expect to get one for the price he would pay for a weedy hack.

In support of that which is here written, mark the words of a Conservative War Minister, spoken in Parliament during the Session of 1859, when referring to the inefficient state of the Army at that time:—

"I will not allude to the measures which the Government, with the sanction of this House, may take to mitigate this evil, but I think it fair that the country should know what are its real resources, and should not rely upon what on paper may appear extremely formidable, but in reality may be weak."

Hear also the explanation of the Chancellor of the Exchequer of the same Government, in laying before the House of Commons the Budget for the year.

"You are now called upon to meet an expenditure, which, legitimate and necessary as it is, has reference strictly and exclusively to your

"own wants—to the wants of the time in which you yourselves are "living. We have come into office with a full conviction that the "great demands made upon the House, are demands both justified and "required by the circumstances of the country.

"I refer it alike to the hearts and understandings of those who hear "me, and of those out of doors who will consider our discussions and "debates, whether we should not shrink from our duty, and disgrace "the memory of those who have gone before us, if we were to hesitate "to say that we would provide for the wants of the day in which we "live, not in such a manner as will further embarrass our posterity, but "out of the resources immediately at our command?

"I am not addressing you in unconsciousness of the increase made "to the Army and Navy Estimates, which unforeseen circumstances "have rendered of immediate necessity, but in considering the "amount of estimates voted, I would say, *it is not the amount to be "considered, but the national exigencies imperatively required for the "country's safety.*"*

Mark well and carefully digest also the words of one of England's noblest sons, Arthur Wellesley, Duke of Wellington, in which he bears testimony to the horrors endured by nations afflicted by foreign invasion, and in which he recorded his prophetic warning against the dangers awaiting England from her disregard of home defence—and although much has been done since those days, so much still remains to do, that they are not inapplicable at the present moment.

"Look at the course pursued by France in Italy and Russia; at "Vienna repeatedly, at Berlin, at Moscow,—the contributions levied, "besides the subsistence, maintenance, clothing, and equipment of the "army which made the conquest! Look at the conduct of the "Allied Army which invaded France and had possession of Paris in "1815! Look at the amount of the pecuniary sacrifices made on that "occasion, under their different heads of contributions, payments for "subsistence and maintenance of the invading armies, including "clothing and other equipments. * * * Then look at the con-"ditions of the Treaties of Paris, 1814, 1815.

"France, having been in possession of nearly every capital in "Europe, and having levied contributions in each, and having had in "its possession, or under its influence, the whole of Italy, Germany, "and Poland, is reduced to its territorial limits as they stood in "1792.

"Do we suppose that we should be allowed to keep, could we "advance a pretence to keep, more than the islands composing the "United Kingdom, ceding disgracefully the Channel Islands, on which "an invader had never established himself since the period of the "Norman Conquest?

"I hope that the Almighty may protect me from being the witness "of the tragedy, which I cannot persuade my contemporaries to take "measures to avert."

* These are noble words, such as are worthy of an English Minister, and specially worthy of him by whom they were spoken, our present Premier, Benjamin Disraeli.

If we in our day wish to be assured of the accuracy of that which is thus so forcibly described, we have only to turn our attention upon those terrible events which have taken place under similar circumstances within the last four years, during which time they have been repeated under conditions of fearful aggravation.

Should we not then be eager to profit by the lesson which has thus been recorded for our instruction in this blood-stained page of history —being thus forewarned, should we not unite as one man in the determination to be fore-armed, and should not the high aspiration, the earnest prayer of every true-hearted Englishman at this moment be, that we may be wise in time, that we may look to our bolts and bars, and take measures to render them so thoroughly secure as to ensure the maintenance of our supremacy abroad, and our perfect security at home?

That England may still be respected and free,
The envied of nations, the Queen of the Sea.

Friday, April 9, 1875.

General Sir WILLIAM J. CODRINGTON, G.C.B., &c., &c., Vice-President, in the Chair.

Discussion on Sir E. Warde's lecture, and on Recruiting, which formed the subject of the Essays written for the Gold Medal.

Captain Hime, R.A., F.S.S.: As the object of this meeting is discussion, I shall simply give a *précis* of my Essay, condensing my remarks as much as possible.

There are but four possible systems of recruiting. The first is the mercenary. In the present political state of Europe the mercenary system of recruiting is impossible. The second is the vicarious, or late French system. The history of the French Army, from 1792 to the present day, I think, points to one conclusion, and to one conclusion only, and that is, that the vicarious was a sham. The third possible system of recruiting is our voluntary system. There are various forms and modifications of the voluntary system, but after an expenditure of an unparalleled and enormous amount of money it only supplies us with men who physically and mentally are the very worst we could select from the materials at our command. The fourth, and last system is, the system of conscription. Let me explain that I do not propose conscription, I merely say conscription is inevitable, and will come upon us sooner or later. When it does come, I have no doubt, if it is properly carried out, it will give us the best Army we have ever had, at the very cheapest cost.

I wish, before sitting down, to make two observations. The first is, with reference to a very kindly critique which appears in to-day's *Standard*. My critic remarks, that the Army which I demand, is numerically of preposterously large dimensions. He says I have asked for a first line of 100,000 men. I have done so; but a glance at the Army Estimates for this year will show that we have at this present moment, or at least we had on the 1st of January this year, under arms in England 96,279, men. I trust, therefore, my hearers will agree with me that my demands are not very extravagant if I ask for 100,000. If any purist insists upon an army of 96,279, I shall be the first to receive it. I have merely taken 100,000 in my Essay as a matter of round numbers.

The second observation I wish to make is this, and I make it because it may save time by putting a stop to useless discussion. From some unfortunate carelessness in my language the *Pall Mall* has come to the conclusion that I am fond of conscription. I beg to say I have no *penchant* whatsoever in favour of conscription. At present my life and the life of every Officer in this place is comfortable and easy, if we compare ourselves with lawyers, and doctors, and other professions. Under any system of conscription whatever, from leading this comfortable and easy life, we shall become converted, so to speak, into drudges and drill-sergeants. Therefore I say my private interests, and the private interests of every Officer in the Army, are dead against conscription. But we are citizens as well as soldiers, and it is our duty to sink our private interests when we find they are in opposition to the public good. I look upon conscription as I do upon the amputation of a broken and withered limb. The operation may be, it must be, painful; but it is inevitable, and we must forget our private interests if the result be likely to prove a great public good. As discussion is the object which this meeting is intended to promote, I shall delay you no longer.

Major-General Sir Lintorn Simmons: Sir William Codrington, Ladies, and Gentlemen,—I think that the Members of this Institution, and the country generally, are greatly indebted to the Council for having established a medal to promote study in the

Army, and to benefit the Service; and that they are particularly indebted to them for having selected this important subject for the essay of the present year. They did me the honour to ask me to be one of the umpires for awarding this medal, but I felt it my duty to decline, because I have written a good deal on the subject, and therefore, perhaps, could not have approached the consideration of the essays without prejudice; and certainly, able, interesting, and well-written as Captain Hime's essay is, I differ in some very important points from it. I cannot admit with him that he has exhausted the question of voluntary enlistment; on the contrary, I believe voluntary enlistment is the real means for getting out of the difficulty in which the country is placed. I believe that conscription, which is a Continental invention, is not at all adapted to this country. If conscription were put in force for a couple of years, the country would resist it, and would entirely give it up. I do not see my way to a selection, from the very large number of young men who arrive at maturity every year, of the quota that is annually required for the Army. People run away with the idea that every German is a soldier; this arises probably from a mistaken apprehension of the law. Every man who arrives at a certain age in Germany is liable to military service; but it does not follow, because he is liable, that he is taken; on the contrary, we know that the peace army of Germany is fixed at one per cent. of the population. The population being 40,000,000, the army is 400,000, and is composed of conscribed contingents for three years, being about 135,000 a-year. Now the number of young men who arrive at twenty years of age in Germany is somewhat under, but close upon 400,000; therefore it is evident that only about 35 per cent. are drafted into the ranks of the Army, and 65 per cent. escape. In a country, governed as Germany is, without a Parliament or press in which discussion is as free as it is in this country, the process of selection is comparatively easy; but I doubt very much whether it could be carried out in this country; and if it could, I believe it would be about the most unequal and iniquitous tax ever put upon the country, and that discipline in the Army would be impossible if it were formed in that way.

There is another point in the essay to which I will advert. Captain Hime is not quite consecutive in his ideas, when he proposes a volunteer army for India and the Colonies. Now the number of troops in India and the Colonies is about 84,000, and if to these be added a proportion at home about 16,000, serving upon the same terms, for the purpose of furnishing the necessary reliefs to these troops, they would make altogether a force of about 100,000 men, who, I think every Officer in this room will agree, must be raised by voluntary enlistment. The balance of 82,000, making up the whole of the Army, can alone be enlisted in some other way. Now, I believe that you could not have the two systems of enlistment, voluntary and compulsory, going on together, side by side, and therefore that the whole of the enlistment must be voluntary.

In dealing with this subject there is a matter in connection with it, which I think should precede the discussion of this question, viz., the absolute necessity that exists that something should be done without delay. I see that Captain Hime, in his Essay, says that it would be madness in this country to risk itself with an army of only 60,000 infantry. That, Sir, I think, is far too favourable a statement of our position at the present time.

Captain HIME: I said "less than." "On the 1st of January, 1873, our Army "numbered 194,227 Officers and men. But where were they? There were 62,834 "in India; 1,373 on their passage from India; 23,590 in the Colonies; and the "remaining 103,618, of whom 62,384 were infantry at home. This grand result of "our expenditure of some £15,000,000 was that the safety of the British islands "was staked upon an army of less than 60,000 infantry."

Sir LINTORN SIMMONS: And "surely it is sheer madness to risk our liberties in "times like the present upon the success of an army of 60,000 infantry." Now, I quite agree with Captain Hime on that point—that 60,000 is too small a force for this country to risk its liberties upon; but, Sir, we have not anything like 60,000 infantry, effective for war. Every soldier must agree with me, that boys are not fit to serve in the Army, and certainly are not fit for war. What is the real state of the case? Our Government are so liberal that they publish at the small charge of sixpence a Blue-book, entitled the "General Annual Return of the British Army,"

which is in the hands of the foreign military *attachés* in this country, whose duty and business it is to study that return, and to send information derived from it to their respective Governments, who thus know to a man what our strength is, far better than the English public do, and far better than most of the soldiers or Officers in the Army. What, then, is the real state of the case? I will take my facts from this, and another published return, both of which are vouched by the signature of the Adjutant-General. On the 30th of November, 1873, the home Army consisted of 47,854 Infantry and 5,611 Guards, making together 53,465. Of these men, there were under twenty-one and over forty years of age 15,220; recruits above twenty-one, who had joined within the year, and, therefore, cannot be taken as trained soldiers, 2,697; there were sick and in prison, 1,844; Indian invalids, 973. (I am only taking the proportions of these latter that are due to the infantry.) Then there will be always some men at the depôts, and others employed elsewhere, and assuming these at the small number of 4,731, the result is that 25,465 must be deducted from the 53,465 so called effectives, which will leave 28,000 as the total real effective infantry at home, with the colours, fit for war. In addition to this, there are the Reserves; I see it was stated in a debate in Parliament a few days ago, that the first and second class Reserve amounted to 7,829 men; that there were 29,195 enrolled pensioners, who are mostly old soldiers over forty years of age, and therefore not fit for active service in the field; they may be very good for garrison duty, but they certainly are not fit to take the field. Then there are 28,226 men in the militia reserve; but from one return it appears that upwards of 10 per cent. of the militia deserted in one year, therefore there must be a very large proportion of these who would not be found; and besides, the proportion of boys under twenty-one is as large, or larger in the militia, than in the regular Army; therefore I put these down at about 17,000 men. And I maintain, from having seen several militia regiments, that they are not trained sufficiently to take their place in the ranks of the Army—they can only be looked upon as a reserve to fill up, after a few months' training, the first casualties that arise in war. What is the sum total, then, of this great force we possess? It is no use having cavalry or artillery more than in proportion to the infantry. Assuming that the regiments are raised to the standard laid down in the book put into all our hands to encourage the study of the art of war,—the rules for the Kriegsspiel,—and that they are organised in accordance therewith into brigades and divisions, I find that this infantry would suffice for four divisions. In other words, they might be made into two small *Army corps* of two divisions each; and supposing there were two brigades of cavalry, guns and engineers, to correspond added to them, they would altogether make up a small effective army of 46,051 men of all arms, with ninety-six guns. I think, therefore, Captain Hime is perfectly justified in saying we risk our liberties upon an Army of less than 60,000 infantry.

In making this calculation, I have assumed a point which I know is much debated, viz., that boys under twenty-one years of age ought to be excluded, in considering the fighting effective strength of an Army. On this point, I will read an extract from a lecture given in this room, by a medical officer of considerable repute and long experience, Dr. Leith Adams. He says—" It was a custom, in former times, " when the political state of Europe did not call for a large British Army, and " when recruits were plentiful, to select only men of large stature; but, in those " days, there were no camps, no manœuvres, or one half of the trying work to which " our young soldiers are now exposed, so that the lad of seventeen grew up to " manhood in easy country quarters, with far fewer chances of getting his frame " overtaxed than the youth of the present day; moreover, physically, he was better " fitted to withstand the strain. Now, it seems to me most advisable that, for " duty purposes, a very broad line should be drawn between the nature of the im- " mature and of the fully-developed soldiers." And now follows a statement to which I wish particularly to direct the attention of military men. "It is not only " pernicious to the interests of the Service, but also cruel, to expect a lad in his " teens to do the work of a full-grown man. I speak emphatically in the matter, " from the consciousness that the evil consequences of over-work, though apparent " to the surgeon, are not sufficiently estimated by many military men." As a military man, agreeing with Dr. Adams in what he says, I must repudiate the

idea that we do not "sufficiently estimate" these evil consequences. It is impossible for Officers, carrying on the duties of the Army, to draw the distinction he suggests. The only distinction that can be drawn is by not sending young men abroad; but when young men and old men are doing duty together in the same regiments, it is impossible to say that the older men, who are only receiving the same pay, are to do more duty than the younger men; therefore, we cannot draw that distinction in their duties that he would appear to desire between young men and old men. There is another medical officer, of very high standing, who is recognised and always quoted as one of the highest authorities on such matters, I allude to Professor Parkes. In his work on "Military Hygiene," he says, "If "the State will recognise the immaturity of the recruit of eighteen years of age, "and will proportion his training and his work to his growth, and will abstain "from considering him fit fully for the heavy duties of peace and for the emer-"gencies of war until he is AT LEAST twenty years of age, then it would seem that "it is not only no loss, but a great gain, to enlist men early." I think, if we have soldiers in the Service who, in the estimation of the highest medical authorities, are not even fit for the heavy duties of peace, we cannot call them efficient soldiers for war. Dr. Parkes says *at least* twenty years of age. In the German Army, conscription begins after the completion of twenty years of age, but the fact is that a greater proportion of the youth in Germany are put back for one year before they are drawn into the Army. That is the result of the experience they have gained from the working of the law for drawing conscripts at twenty years of age. The Russians have adopted twenty-one years; and soldiers must agree that it is most desirable that we should only have mature men. What is the consequence if they are not fit? The young men, after some slight exposure and a few fatiguing marches, go into hospital and seldom rejoin the ranks. You will want far larger reserves, if you send these boys and old men to war, than if the Army is all of mature age. To show the importance, in an economical point of view, of this matter of age, I will refer to the Report of the Medical Department upon the health of troops in India. I find the death-rate per 1,000 of men under 21 years of age is 9·00; of men between 20 and 25, 17·30; between 25 and 30, 23·85; between 30 and 35, 32·99 per 1,000; between 35 and 40, 41·38 per 1,000; and over 40, 63·50 per 1,000. I have taken the trouble to make a simple calculation from the returns in which the ages of the European Army in India are given, on the 1st September, 1873, by which I find that, if the men in the Army had all been between the ages of 20 and 30 throughout the year, instead of being, as they were on that day, there would have been 380 fewer deaths in the year, 592 fewer men sent home as invalids, and 840 fewer men constantly in hospitals. In other words, the Indian Government would have been saved the expense of sending out 380 men to replace those who had died; of sending home 592 invalids and sending out 592 recruits to replace them; and they would have had a battalion of 840 more men effective out of that small Army of 60,000 Europeans, with which we hold 200,000,000 of people in check. The saving in money arising from this precaution, that is, by taking care that the men of the Army were all between the ages of 20 and 30, without allowing for any recruiting or depôt expenses, would be £230,000 per annum, which would go a long way towards improving the condition of the soldier, and in giving him better pay. Of course, this is not the place to enter into the details of these calculations. I have gone into them with great care, and I invite any gentleman to test their accuracy in any way he may think proper.

I will now make a few remarks on the cost to the State of recruits under age, because I think this is one of the most important points we can possibly discuss in this room, with a view to coming to a decision on this important question. I have made a table, showing the amount of money actually spent by the State in the wages and maintenance of soldiers in different branches of the Service. I must inform you that these calculations are founded upon the report of the Joint Committee appointed by the India Office and War Department, to determine the proportion of expenses to be paid by India for the Army, their instructions being that it was to be determined upon the basis of actual charges. I have taken their estimates, and only altered them so far as recent regulations required, and the following are the results:—A cavalry soldier costs, for his first year of service,

£71 4*s.* 8*d.*; an artillery soldier, £64 10*s.* 1*d.*; and an infantry soldier, £50 1*s.* For the second and subsequent years, the cavalry soldier costs, on the average, £82 8*s.* 9*d.*; the artillery, £49 8*s.* 4*d.*; the infantry soldier, £37 19*s.* 5*d.* Hence, if a cavalry recruit joins the Service at 16 years of age, it appears that, by the time he has arrived at 21, he will have cost the State £400; similarly, if he join at 17, he will have cost £318; at 18, £236; at 19, £154; and at 20, £71. In like manner, if a lad join the artillery at 16, he will, on arriving at 21, have cost £262; if at 17, £213; at 18, £163; at 19, £114; and at 20, £64. If an infantry lad be taken at 16, he will, when he arrives at 21, have cost the State £202; if at 17, £164; at 18, £126; at 19, £88; and at 20, £50. Working on the same basis, I find that the cost of training effective men for the Service in the three branches is £62 for the cavalry, £54 for the artillery, and £32 for the infantry. As an example, to explain the bearing of these figures upon this question, it will be seen that a cavalry soldier who joins at the age of 18 will have cost the country £236 by the time he has arrived at 21. Now, the training of a cavalry soldier costs only £62. Taking this sum from the £236, there remains £174, which this youth of 18 will have cost, on arriving at the mature age of 21 years, more than a man who had been caught just in time to be fully trained by the time he completed his 21st year. Such a man would have five years to serve to finish his Army service of eight years; the additional sum, therefore, paid for catching him as a young man amounts to £34 a-year for each year of his effective service, or is equivalent to an increase of 1*s.* 10*d.* a-day to his pay; that is rather a large sum to pay as a premium for boys. If it were added to the pay of the cavalry soldier, it would probably do away with the necessity of enlisting boys, or of discussing the necessity for conscription. Similarly, an infantry soldier, taken at the age of 17, costs £164 by the time he is 21; deducting from that £32, the cost of training an infantry soldier, there remains £132; as he will then have only two years to complete his Army service, each year of that service will cost £66, in addition to his pay, or 3*s.* 7*d.* for each day of his effective service. It strikes me that this would get us a better article, and I think it has a very important bearing upon the question whether Captain Hime, in his essay, exhausted the subject of voluntary enlistment. I have gone a little further with my calculations, and find the cost of boys who joined the Army under 20, during the year ended the 30th of November, 1873, on arriving at 21, after deducting the cost of training an equal number of men, would be as follows:—There were 9,858 boys, their total cost, without any depôt expenses, would have been £741,037. That is a large item in the annual estimates. This sum would have been sufficient to add 5*d.* a-day to the pay of every man enlisted for the whole period of his Army service. These figures have a very important bearing upon this most interesting subject, but I can give you a few more which will, I think, cast a still stronger light upon it. Taking the returns of the last two years, I find as follows:—Of the 23,568 recruits who enlisted in 1871, 6,289 or 267 per 1,000, had disappeared from the ranks, in one way or another, before the end of 1873, and of these 6,289, 2,505 had disappeared in that year 1873 alone. of the 17,791 recruits who enlisted in 1872, 4,196 had disappeared, or 236 per 1,000, before the end of 1873; and of that large number 3,514 had disappeared in 1873. Then, of the 17,194 men enlisted in 1873, 2,858 disappeared before the end of the year in which they were recruited. When we put these figures together, this remarkable result is obtained:—Out of the three years' recruits, of whom there were 58,553, one half enlisted for short and one half for long service, 13,343 had disappeared before the end of 1873; and, of those, 8,877 had disappeared in that year. What is the bearing of this upon the recruiting of the Army? Why, the whole question of voluntary enlistment or conscription hangs, to a very great extent, upon the number of men you want. If none of these men had disappeared in the year 1873, and not one of them, be it remembered, went into the Reserve, the Inspector-General of Recruiting, instead of requiring 17,194 men to supply the wants of the Army, would only have required 8,317, a great saving might have been effected in the recruiting department, and a great deal of embarrassment and trouble. Next, what has been the cost of these 8,877 men who disappeared during the year 1873, with less than three years' service? I make it that they cost the country, in actual money, £596,563, exclusive

of depôt charges; if the depôt charges are calculated, as they can be calculated from the estimates and other sources, you will find that the actual expense of the recruits raised at these depôt centres, in the year 1873, is about £86 per head; but, as the depôts were not in full operation for the whole of the year, they will probably improve very much, and may raise more recruits. Taking the cost, therefore, at £50 a-head, we arrive at the enormous sum of £1,040,000 which these 8,877 recruits will have cost the country during the short time, averaging less than one year, during which they had been in the Army. I challenge any gentleman to dispute those figures. I have gone into them with the greatest care, and believe them to be fairly accurate, and further, that the money thus spent would have done less harm if it had been thrown into the sea. Men entering and leaving the Army in such numbers, before they can possibly have rendered any real service to the country, unsettle their comrades and do much harm. So large a sum of money would go a very long way towards getting us out of our difficulties. We are apt to judge of the condition of the Army, and of its popularity with the classes from which recruits are derived, from the number of deserters, but I do not think this number, at the present day, affords anything like a criterion by which to judge of the difficulty of getting recruits. There is a far more important question at the back of it, and that is, whether the soldier is satisfied or not. With respect to men under six years' service, I find that, out of 24,594 who enlisted in 1870, 7,486, or 304 per 1,000, had disappeared before the 1st of January, 1874; that, out of 29,080 who were enlisted in 1868 and 1869, 10,479, or 360 per 1,000, had disappeared from the ranks before the end of 1873, 3,558 of whom had gone within that year. This looks very like dissatisfaction, as if the men are not satisfied with their position. Again, of the 86,041 men under twelve years' service, who enlisted in 1862, 1863, 1864, 1865, 1866, and 1867, 40,327 only remained in the ranks, while 45,714 had disappeared. These are large figures, and give the working of the Army, not from the experience of individuals, but from the experience of masses. Thus we find that 531 of every 1,000, between six and twelve years' service, had disappeared from the ranks, and of those 3,343 had disappeared in the year 1873. The total number of men who disappeared in the single year 1873, having less than twelve years' service, was 15,967, of whom 876 only were transferred to the Reserve. A portion of these, about one-fourth, may be accounted for by desertions, some were discharged as invalids, some died, and the remainder purchased their discharge.

The numbers who disappeared, in various ways, during the last five years, will give you a fair criterion of what the feeling of the soldier is. Of the men who were discharged in the last five years, 6,110 were discharged on completing their first period of service. Now, I think, considering that they had twelve years' service and only nine more years to serve for pension, the fact of their not re-engaging does not look as if they were altogether satisfied. 19,642 were discharged as invalids, and 12,088 by purchase. It will give you an idea of the estimation in which the soldier holds the advantage of the Army, when 12,088 men are willing to pay from £5 to £35 a-piece to get out of the ranks; 5,703 were discharged free by indulgence, or, in other words, gave up about £200 of acquired value in their prospective pension; 8,044 as bad characters, and 17,947 deserted, making a total of 69,534. During the same five years, there were 11,442 pensioned or sent to the Army Reserve, 11,331 died, and 7,547 left from unassigned causes. The total number that disappeared from the ranks was 99,854, including deaths and all causes, and I think we may safely conclude that 69,534 of these would not make known the advantages of the Army in a manner calculated to facilitate the operations of the Inspector-General of Recruiting. These 69,000 men would bring home the advantages of the Army to the classes who furnish recruits in much clearer and better understood terms than Army official circulars or letters sent by philanthropical Officers to the newspapers. They bear living, speaking testimony. I now think, Sir, I have adduced statements enough to prove that voluntary enlistment is not on its fair trial. I believe that, if it were put upon its fair trial, and if proper terms and proper conditions were held out to young men to encourage them to enter the ranks, and better pay given, you would have abundant men, coming voluntarily forward to serve in the Army, and who would not require, as the writer of the essay seems to think, additional money for the risk inseparable from

a soldier's life; all that they would ask would be, that they might serve their country, in an honourable profession, without loss of money. If an artisan enters the ranks now-a-days, who is in receipt of 4*s.* or 5*s.* a-day, he has to give up what is equivalent to fifty or sixty per cent. of his income for the honour of serving his country, and I do not think that condition can be sustained. We must pay men better. Having trespassed so long upon your time, I cannot now proceed to develop what I think should be done to place our Army on a right footing, but I think I have said enough to prove that something must be done to put voluntary enlistment on a better footing before it can be condemned.

Colonel LORD WAVENEY, A.D.C. to the Queen, F.R.S.: This is a discussion of a most important character. As I apprehend, it turns first of all on the means of raising our Army; the amount of Army we shall be able to raise; and for what purposes we shall design that Army.

I cannot think that there can be any very great difficulty in getting, under proper regulations, such as we may hereafter arrive at, the amount of available force that may be regimented for the public service. For instance, I see the Police Force perfectly filled up, I see the Railway Service kept in good working condition, and we naturally inquire why it is that the Military Land Service of all the services should alone be in this state of deficiency. There may be some points peculiar to this country, as indeed I think there are, but still they may be obviated. First of all, after remarking on the interest with which we must all have heard the details given by Sir Lintorn Simmons in which, however, the excess appeared to be as regards the payments we make and the deficiencies in the number of soldiers we raise; still I do not think it possible that in this country the period of military service can be postponed under our particular, economical, and industrial conditions, to the period at which the soldier would have passed, so to say, from the gristle into the bone. I have been particularly struck with that very great difficulty. The age at which we must take our soldiers, I apprehend, must be below that of perfect adolescence and capacity for enduring the severities of military service. But are there no means by which we may retain the soldier with the standards during the period at which he is growing to his strength? I presume the depôt centres are intended in some degree to fulfil that duty; and supposing the youth of the Army, without reference to the particular battalions for which they were designed, were detained at home from foreign service until they were able to meet the necessary hardships of the climate, a great deal of the difficulty would be got over. That is merely as regards the physical circumstances attending our enlistment. But there are one or two other points, one of which has been discussed with great clearness and perspicuity by Sir Henry Havelock, in a paper published by him some two months ago, in which he speaks of the moral considerations that would attend the young soldier and the better classes in joining the Service; and he proposes a certain selection, as it were, to be made in the regiment, so that those who come from the more-educated classes should be associated together; and he proposed to form a lodging class answering to the one year's cadet of the German Service. There is no doubt a great deal of the difficulty arises in the barrack-room itself. I apprehend the educated young man who wishes to join the Service does not desire to live the life of the barrack-room, which, however well disciplined the regiment may be, must be unacceptable to him. I found a strange illustration in a very strange quarter, of the means of getting over that difficulty. My own idea was that the barrack system of England itself might be very much improved; but I am told something obtains in the Guards' barracks in this country which might be carried out more generally, that is to say, that the soldier from the time he leaves his barrack-room should never go to it except when he goes off guard to put on his "fatigue"; and that he should, during the rest of the day, be in public rooms for recreation, amusement, and so on—in fact that he should go through the life which most of us gentlemen, either at military colleges or at public schools, have ourselves gone through. Thereby—what is the most important point for the educated soldier—his self-respect would be preserved to him from the time he entered the Service until the time he quitted it. Sometime since, there was a discussion in the House of Lords on the convict establishment at Gibraltar, and that led me to talk to an Officer well acquainted with the convict system elsewhere. He said a great advantage was found in Portland from apportioning off the whole of the

sleeping accommodation into single cabins for the convicts. No doubt that system had a great effect in improving their condition; and if regiments were broken up into squads in that way, my impression is a great deal might be done by giving that opportunity of withdrawing, so to speak, from the ordinary rough life of the barrack which the well-educated young man would desire when he entered the Service.

There is another point on which I desire to speak. I turn to the finest body of soldiers in the world without exception, taking them on all points; and those who are familiar with them will justify my assertion. The 12,000 men of the Irish Constabulary have none superior to them in any part of the world. Bigger men there may be, but smarter men with their arms, or better adapted to learn every tactical movement, I do not know. Besides this there is an enormous amount of intelligence in these men, who, when in the Service, are always under the operation of a law of discipline and self-respect which develops their natural powers. I have heard of four foreign corps which are in precisely the same position. Perhaps some Indian Officer may be present who remembers Bailey's, and Skinner's, and Frazer's horse, and the Zemindar regiments. In the discipline of these two services was the soldierly self-respect that we want to develop, and it made such soldiers of them as neither India nor Ireland have ever before seen. I lay this before you to show that what has been done elsewhere may be done here. I have just returned from Ireland, and knowing that a discussion was likely to take place, I inquired what the rate of pay was for the youngest soldiers of the Irish Constabulary. I find, in a rough way, it is about £50 per annum. Those men find their own pensions, that is to say, they subscribe to a fund. With regard to the question whether we can improve the quality of our soldiers, it must always be borne in mind that the recruiting surface in England is limited, and that the productive recruiting power of this surface is limited also. We know that the rural population on whom we have chiefly to rely, does not increase; while the urban population does. I have found myself, from my own experience, with 3,000 young soldiers whom I have myself recruited, that the number drawn from the recruiting surface varies annually in a very trifling degree, though the men vary very much in increased efficiency and also in size. The recruits I got from 1853 to 1863 were small men compared with the men I have got from 1863 to the present time. With regard to the number of troops we may expect to have, taking the analysis of the gallant General that we have only 50,000 men and 100 guns—50,000 men and 100 guns handled as British soldiers ought to be, and projected after the fashion of British war, would create an enormous diversion in contests of whatever magnitude. The force of England must rest on the sea. The British soldier must not adventure in his comparatively small musters on the great plains where, by the mere weight of the enemies, he may be crushed. Let the British soldier be placed where he can communicate with the sea; and then will be seen what the military power of England is. The land military power of England is the small weight at the end of the steel-yard. It depends, for its force, on its place on the arm of the lever, and when placed right, there is no opposition that it will not weigh down. Let me give you an illustration with regard to the intervention of British soldiers during the French war. Supposing that, resting on the sea, we had sent our troops with 50 guns to the Seine, and a like number to the Loire, I think if the siege of Paris had not been raised, its history would have been very different. Under the shelter of the camp of Orleans, defended by British soldiers, the gallant young Frenchmen who perished in thousands would have had time to consolidate themselves; and I fancy it is probable the German picquets might never have been seen so far as the Loire or on the banks of the Seine.

With regard to the condition of this country, in speaking of the conscripts, Captain Hime has spoken of one conscription which is familiar to us all—the best conscription we have, the most effective, and one that has already done us good service, and that will continue to do so. I speak of the militia. In the militia, a force exists which, under the operation of the law, can be brought to the statutory level. Bring to the statutory level the operations of the militia, and it is sufficient to raise troops enough to defend this country. If the 50,000 men were sent on an expedition such as I spoke of, there would still remain at home a large body of men hardened to a great extent to the requirements sought of them, and needing only three or four months' drill to fit them for active service. My last suggestion is this. I see the

enormous difficulty at the present time of raising men such as we desire in sufficient numbers by our system of voluntary enlistment, even with increased pay or with the additional facilities in barrack life of which I spoke. I see that, but I do not see why the militia should not take their share of the national defence. If I have the good fortune to have an opportunity of giving my opinion elsewhere, I should propose, as during the Crimean war and the Indian mutiny, that some of the militia regiments should be always on foot. There we might meet the difficulty of age. Our recruiting power is a constant quantity. Men come to our service who are growing lads. They are able to get into half a year's work on the farm; and the rest they must make out as they can. I would keep the militia brigades on foot two years. The young men especially should be kept with their brigades, which, in succession, should take up their turn with the home armies. These men would be willing enough to remain in the first instance; and that gets rid of the great difficulty always stated with regard to the militia regiments, and they probably would pass on to the regular service. I must say, in conclusion, that whether, with regard to the armies we are to raise for foreign service or for home defence, I am still full of confidence; but I think we are indebted *most thoroughly* to Captain Hime for the light he has thrown upon many dark places of our system; and I trust he may long continue to give such illustrations.

Mr. Holms, M.P.: As I understand the time allotted to each speaker is very limited, I think it would be well for me to go at once to the practical points which, I take it, we are assembled to discuss, namely, how are we to get as good a supply of men for our Army as we get for any other employment in the country? I have read, with very considerable interest, the admirable Essay written by Captain Hime. I rejoice to see that he has come to one or two very sound conclusions. He does not believe in the militia, and supports the view that has been so ably put before this country by the gallant Officer who has just addressed us with so much ability, Sir Lintorn Simmons. I am glad also to observe that Captain Hime has come to the conclusion that it is possible to make an infantry soldier in a shorter period than three years. But I do not in the least agree with him that we have even approached the day when we need resort to conscription to obtain recruits. I would like to see the man who would be bold enough to go to the House of Commons and say that the day had arrived when we must cease to engage the British Police by ordinary and voluntary means, and must resort to conscription. The truth is, if the British Police were to resort for three months to the system that exists in the British Army to obtain men, in three months it would be precisely in the same condition as the British Army is now; but if the British Army were to take a little from the system of the British Police, they would arrive at the same result. Colonel Henderson, on the one side of Whitehall, has no difficulty in getting as many men as he likes; why should the width of the road preclude the Horse Guards from following the same example? If they did, the proposal of conscription would be equally uncalled for in the case of the Army as in that of the Police. It is the question of giving men that which will attract them. We must apply the same practical every-day simple mode of giving value for what we want. What would people think if this assembly was to come to a resolution that we were to buy Consols at ninety-two, when this morning the price is ninety-three and a quarter to ninety-three and three-eighths? Why the whole nation would imagine we had taken leave of our senses; and that is precisely the position we are in with our Army. Captain Hime has added much to our information. He has given us some very admirable returns. There is one which I have looked at with great interest, which shows that the market-price of agricultural labour per week in Northumberland and other counties is 14*s.*, 15*s.*, 16*s.*, and 18*s.*; and what is your price? 13*s.* 1¾*d.* Therefore you are just precisely in the position of offering a price so low that we have no hope of getting the men. But it is not a question of money only. Do not for a moment imagine that you will get the men, supposing you offered the money. The working classes of this country are a set of men probably higher in tone than many people are inclined to believe. Those men will not join the ranks until you show that you will take good care that men of good character only go into the Army. What do you do just now? You do the very best thing possible to keep men of good character from going into the Army. I see here one gentleman who

knows very well about the Constabulary, and I would ask anyone who has had to do with the Constabulary this question: Supposing a man came and offered himself to service, and you had arranged pretty nearly that he was fitted for that service, but you said—"Quite understand that you must be prepared at any "moment to go to India, to go to the Cape, to go to the West Coast of Africa, or to "go to Canada," what would the man say? He would say, "No thank you; good "morning, I won't join." Another man comes who, perhaps, has a desire to see the world, and you come to precisely the same position with him, and then you turn to him and say, "I cannot agree to take you because you do not wish to stay "at home." The man wants to go abroad; and, finding that he cannot be sent abroad, he says, "No thank you, I won't join." What is the result? The result is you have an Army of men who neither care where you send them or what you do with them. The best men avoid our service. You must have men who will be in this position—that not only will they do what you want, but that they will do it willingly. Certainly you are bound to have men who will serve you anywhere in case of war, but in case of peace why should you not give the man the choice of serving at home or serving abroad according to his wish? I believe our Indian and foreign service is most popular; and I believe also you might make your home service equally popular if we had a very short service, and gave them better pay and some prospect of a Government situation, and were also able to keep them in the Reserve by a very considerable retaining fee. There are of course a great many points connected with this question, but I will not trespass upon your time. I believe if you gave the men the choice I speak of, you would attract men of good character, and you would probably have a new class of men altogether. There are, at the present moment, abundant applicants for Government situations, and also for clerkships in offices in the City of London. I believe you will get that class of men to join the ranks very readily if they were put upon the footing to which I have referred. As to the question of getting men for voluntary service, it appears to me there is no difficulty whatever as regards numbers. At the present time we are enlisting annually, between the militia and the regular Army, something like 45,000 to 50,000 men; and, as regards our volunteers, I believe there is a number passing through the ranks of something like 45,000 annually. We have for the last five years been raising men at the rate of from 90,000 to 95,000 annually, every one by voluntary service, so that practically it appears to me there is no difficulty in getting men if we only organize the system upon such a footing as would attract the class of men we want, and had a real short-service system; as yet it has been so but in name. I believe until you cease to make the Army so easy to get into, men will not appreciate it at all. I believe if you stopped all recruiting for a month, and considered what should be done, men would begin to see you would not take on everybody that offered themselves, you might possibly, by-and-bye, begin to find some of the better class of men coming forward, even under the present system. The other day I was present at an inspection of recruits; there were twenty-five, of whom eight were very good men. I believe if they had accepted those eight, and said to the remaining sixteen or seventeen, "we have no room for you," the chances are, by-and-bye a better class of men would come forward; for the truth is we take anybody who offers. The question is so large, it would be impossible for me even to enter upon it. I have to thank you very much for the honour you have done me in inviting me here, and permitting me to offer these few remarks.

Colonel the Hon. F. Thesiger, C.B.: The last speaker has fallen into the general error that appears to me to pervade nearly all civilians, that the Army is composed of the very dregs of the people; and Captain Hime has given some colour to that opinion in saying that the Army is composed of the residuum of society. I think all Officers who have served regimentally will agree with me that the thoroughly bad character is the exception and not the rule. There are a great number of wild young fellows in the Army no doubt, but these are the very men who make the best soldiers; and I should like to know if we were to enlist in the Army men only of approved, steady character, what would be done with the wild ones? The fact is, the Army is really a grand reformatory for society, and I consider that it is an unmixed benefit both to the Army and to the Service at large that we should

recruit from the class which now fills the ranks. I do not mean to say I should wish to exclude those of a higher or better class; on the contrary, there are prizes open to them in the shape of non-commissioned rank, which ought to be sufficient inducement to them to join.

Of course conscription is a very easy solution to the recruiting difficulty, but all those that have yet spoken have allowed it to be impossible, and it is useless to discuss that point. The question is how, if we were called upon to send an army into the field to-morrow, we could manage so as to efficiently recruit that army and keep it up to a proper standard of numbers and efficiency. What we want is no doubt that our recruiting system should be so improved that, retaining our voluntary system, we shall be able to spread over the length and breadth of the land our recruiting agencies, and thus obtain every man who has an inclination to be a soldier. I believe the brigade depôt system, if fully developed, would meet the case as well as it is possible to meet it, but a real amalgamation between the militia and the line is indispensable. I do not agree with Captain Hime or with Mr. Holms in their depreciation of the militia. I believe it to be, when properly organised, a most valuable addition to our Army. I would completely fuse the militia with the line; the militia should be the recruiting field for the line, and the present depôt-company system which exists should be done away with. Let there be one or two companies of militia permanently embodied, and let them do the work of recruiting throughout the land. But before that could be well done, some change ought to be made in the officering of the militia. I do not wish to make any comments upon the present class of Officers; I believe they are extremely good, but I do believe if it were made a *sine quâ non* that the Officers of the militia should be Officers of the regular Army, at all events in the higher ranks, that fusion that I advocate between the militia and the line, would be met to the fullest extent. Everybody remembers during the Crimean war the splendid militia regiments we had, and how, in many respects, they were equal, if not almost superior, to some of the line regiments; but unfortunately they were of no use to us. They went to the Mediterranean, and there they stopped. When we had to recruit our Army, the reinforcements had to pass those men on their way to the Crimea. This must have been extremely galling to those militia Officers and men, and they must have felt that they were only considered fit to do garrison duty, but were not to be trusted to meet the enemy in the field. I believe if the organisation of the militia were so far altered as to allow that, by an Order of Her Majesty in Council, the militia, during times of national need, when we are sending forces abroad into the field, were liable to serve before the enemy, that instead of diminishing the recruiting it would rather increase it. Let us look to our militia as our reserve; let them be blended with our regular forces; let them be part of the line. Let our Officers go from the active Army to the militia, and exchange back again, if they please. Let there be a thorough amalgamation between the two, and I believe, in great measure, our recruiting difficulties would be met, and we should find, during war, there would be volunteers in plenty to recruit our force; and, if necessary, we should have splendid regiments to take their place in the line of battle alongside of our line regiments.

Long service is far better than short, as the Army, under the present system, is not looked upon as a profession. I myself, from an experience of thirty years, can distinctly remember how, after short service was first introduced, a restless feeling was engendered amongst the soldiers which never existed before. When you enlist a man even for twelve years, he cannot realise that he is not going to leave the Army at the end of that time, although in all probability, when the time arrives, he is anxious to re-enlist. But, during the twelve years, his heart has not been really in his work; he has been always hankering after home, and did not look upon the Army as a profession, in which he was to live and die. This restless, unsettled state has been intensified by the further shortening of the terms of enlistment. Therefore, I think, another solution of the recruiting difficulty would be to go back to the long service. I may mention incidentally that I cannot agree with Captain Hime in considering the volunteers "a harmless joke."

Captain HIME: I did not say so; an Austrian Officer said so: I do not think they are a harmless joke.

Colonel THESIGER: I have the highest respect for the volunteers, but I think

their weak point certainly is the officering. If, when first organised, it had been made a *sine quâ non*, that they were to be commanded by Officers who had served a good apprenticeship in the regular Army, they would never have had the hard words thrown at them that they have now; but the good material exists, and the volunteers, if their services were required, would be of infinite value. In every change, the cost to the State must be taken into consideration. If we proposed to give our recruits £1 a-day, we should no doubt get a very efficient army. The Government, however, must cut its coat according to its cloth, and the State cannot afford to give perhaps more than it does now. The question is to see whether we cannot obtain recruits at the price we are able to pay. Everybody complains of the extent of the Army Estimates, therefore it is not likely that we shall be able to obtain for our soldiers a much higher rate of pay than they are now receiving. The condition of the British soldier has much improved of late years, and they are now extremely comfortable; they have excellent lodging, clothing, and food, and there is no doubt they have not too much hard work; the life of the soldier, in fact, is really a very happy one. One of the principal objections that has been raised to the system of long service is, that after fourteen or fifteen years a man is no longer physically fit to perform the duties of a soldier. There is some truth no doubt in this statement, but I think that a searching inquiry should be instituted into this matter, in order to ascertain how it happens that a soldier, after he arrives at the age of only thirty-eight years, having served say twenty years, is no longer fit for the active duties of his profession. I feel sure that any Officer who had reached that age would feel rather indignant if he were told he was no longer fit for active service in the field. The question is well worthy of consideration, how can we improve the health of our troops, and prevent them from so rapidly deteriorating, as no doubt statistics fully prove they do. To sum up the changes I propose, I would advocate that the militia Officers should be men who have served in the regular Army, and also that, if possible, the non-commissioned Officers should be of the same class. The younger the soldier, and the less time they are serving under arms, the more necessary it is that they should have experienced commissioned and non-commissioned Officers. That is the weak point of the militia. They are called out for forty-five days' training, and, to a certain extent, everybody is rusty. Naturally, therefore, their progress is not very great. But if they had thoroughly efficient Officers and non-commissioned Officers who had served their apprenticeship in the regular Army to instruct them, the training would be far better, and the results much more satisfactory. I should like to throw the whole duty of recruiting upon the militia. They should not only enlist for some particular regiments, but the brigade-depôt-centres should be opened to every regiment in the Service. As there would be no line-depôt-companies in existence, there would be no likelihood of any favouritism in favour of one particular regiment, and by this means I believe we should tap the resources of the country to the fullest extent.

One other difficulty in the regular Army—recruiting for long service, is, that when in India many men are found physically unfit to remain in that country; they come home, and what is to be done with them? It appears to me if a man engages to serve Her Majesty at home and abroad, and fails in that condition through ill health, it is an unfortunate circumstance for him, but he is no longer entitled to receive the benefits held out to him when he enlisted. He ought to be draughted out of the regular Army, and put into the Home Reserve. The regular Army would thus consist entirely of able-bodied men fit for any service, and the Home Reserve would gain in strength and efficiency by the arrangement, whilst the State would not be put to any extra expense.

As regards the changes in the regular Army, I would advocate long service enlistment to the fullest extent. I would allow every man to remain in the Service as long as he was able to bear arms either abroad or at home, and at the end of his career let him retire with the pension he has fairly earned. After very careful consideration of the subject, I have come to the conclusion that we make a mistake in discharging men from the Army on account of bad character. There is no doubt we inflict an injury on society by turning adrift men who are considered unfit to remain in our Army. They cannot possibly earn an honest livelihood, and to exist, must prey upon society, and eventually become a charge upon the State by being sent

to prison. We want reformatory battalions as there are in other countries, which should be able to take these men and try and make them better, or at least keep them from annoying the well-conducted. Imprisonment for military offences might, under such a system, be almost done away with. At the present moment, how many men in the Army are throwing their duties upon their comrades by being in prison for offences which would be considered very light in civil life? If imprisonment were done away with, it would give more nights in bed to the soldier, which is a most important point from a sanitary point of view, and would act beneficially upon the conduct of everyone in the regiment. Desertion is the great difficulty of the present day, and so long as we continue to enlist men for short service, it is of great importance to find some means of checking it. My remedy is as follows:—Let every soldier convicted of desertion be held liable for general and unlimited service, and let him be at once sent to a regiment in India. Such a measure would, I believe, at once stop the professional deserter, and the Army, both at home and in India, would be benefited.

Major-General Sir E. Warde, K.C.B., R.A.: Having been permitted, only the day before yesterday, to occupy so much time in this room, I propose to detain you a very few minutes now. When I read the Prize Essay, it appeared to me that the principle upon which Captain Hime proposed that the Army should in future be maintained was utterly impracticable, for this reason, that public opinion, universally expressed, admits that the country is not prepared for, and would not accept conscription. That being the case, it becomes necessary to propose some alternative method that the nation would accept, and which the Government would not hesitate to propose for adoption. It has been a great gratification to me to find that there has been much concurrent opinion expressed with regard to my counter proposal. Voluntary enlistment was the principle upon which I proposed that the Army should be maintained, and that, I think, apparently has been received generally as the system upon which we ought to man our Army in the future, as we have hitherto done in the past. Long service with pension, I propose as the best means of inducing men to enter the Army. That also appears to be largely accepted, at all events, by those who have spoken this afternoon. My friend, Sir Lintorn Simmons, says, "No! no!" He is opposed to it, but he argues that some stronger inducements should be held out to attract men to the ranks. I do not agree with Colonel Thesiger in thinking that we give men as much as we ought, to induce them to join the Army.

Colonel Thesiger: I did not mean that; I meant, we give them as much as we can afford to give.

Sir E. Warde: I beg to differ with you there, also. I think, in this rich country, when you consider that maintaining the Army is simply insuring the national property at home, and securing its honour and prestige abroad, you would find, if it was put to the vote, that ninety-nine men out of every hundred throughout the country would not hesitate one moment to pay whatever might be necessary to obtain such an Army, both as to quantity and quality, as is now required. Put an additional tax against conscription, and where would the votes be? All I wish to say further upon the subject is, I desire nothing more than that the Prize Essay and the proposal I have made should be put side by side, and read paragraph by paragraph, and I venture to think that the strongest possible arguments will be found in the Prize Essay itself in favour of the system that I have proposed for manning the Army in future.

The discussion was then adjourned to Monday, the 12th instant.

Monday, April 12, 1875.

(General Sir WILLIAM J. CODRINGTON, G.C.B., &c., &c., in the Chair.)

ADJOURNED DISCUSSION ON RECRUITING.

The CHAIRMAN: Before we commence the proceedings, Sir Edward Warde wishes to add one or two words to what he said on the previous occasion.

Sir EDWARD WARDE: As you have given me permission, I should like to say just three words with regard to some remarks that have been made about the militia and volunteers. I totally and entirely differ with my talented young friend, Captain Hime, in thinking that the militia or volunteers deserve to be spoken of with any other feelings than those of high respect, because I am able, from personal experience, substantially to corroborate what Colonel Thesiger said here last Friday, about the efficiency of the militia infantry, both during and immediately after the Crimean war. And I know, from my own personal knowledge, speaking of the artillery of those two branches of our reserve forces, that there is a large number of excellent good garrison gunners in both of them, and, if I were charged with such a responsible duty, I should not hesitate for a moment to place them in charge of our garrison artillery defences, with two single provisos:—first, that the duties, although they should be, of course, conducted by their own Officers, should be superintended by Royal Artillery Officers; and, second, that they should have amongst them a sufficient number of thoroughly trained and well instructed Royal gunners, to perform those special and peculiar duties which never ought, under any circumstances whatever, to be entrusted to less skilful or experienced hands. I think it is due to both those branches of our auxiliary forces that so much should be said.

Lieutenant-Colonel PONSONBY COX, R.E.: The ground taken by the essayist appears to me to be that, having received three distinct systems of voluntary service, first, the life-long system; secondly, the long-service system; and, thirdly, that which has partially, but not wholly replaced it—a system which is called, or rather mis-called, a system of short service, he has passed judgment upon each one of them, and has pronounced that, for the purpose of adequately supplying our Army with recruits, each has proved to be a failure; thence he has gone on to argue that these three systems being failures, there remains for us no other alternative save at once to have recourse to universal conscription.

First of all, as to the first—the life-long system. That is a system so wholly of the past that I think it quite unnecessary for me to further refer to it. Next, as regards the second system, commonly called the "long-service" system. This has, with the preceding system of life service, one common principle, viz., that under it service is voluntary and continuous. Captain Hime has so extremely ably stated the case against that system that, although agreeing with him that it may possibly be maintained in a modified form for the purpose of providing soldiers for our colonial service, I consider that, as a system for the purpose of supplying the home Army, it is practically dead. I, therefore, shall not occupy the few minutes to which we are very wisely limited by the rules of this Institution, by saying anything further about it. I shall, at once, turn to that system which has been comparatively recently introduced to replace the system of long voluntary service, I mean the system introduced by Lord Cardwell, in 1870 and 1871, and which now obtains. I shall endeavour to examine, as briefly and as rapidly as possible, whether that system be, as alleged, a failure, and, if it be a failure, whether its failure is a consequence of defects that are absolutely inherent in every voluntary system of

short service, or whether its failure is in consequence of defects which are remediable and avoidable.

First of all, in order to be enabled to judge whether it is a failure or not, it is necessary to bring it to some standard, and I apprehend that the one standard to which we must bring any system of service which has replaced a longer by a shorter term, is to ascertain whether such system does or does not provide a greater, a more abundant flow of recruits than the one which it supersedes, because it is transparently evident that the shorter the period of service, the greater the number of recruits you require. We must, therefore, satisfy ourselves whether this system introduced in 1870 has or has not come up to that standard. It is quite clear, when the present system was introduced, it was evident to the mind of its author how absolutely essential it was to its success that it should fulfil the condition of increasing the flow of recruits. In March, 1870, when the system was being explained to the House of Commons by Mr. Cardwell, it was pointed out that its one merit was this—that it was calculated to attract to the Army, in large numbers, a class of men at present deterred from entering it. The words of the Secretary of State for War were very well weighed and precise words, and I think explain precisely what I mean upon this point, in language very much better than my own. Lord Cardwell, March, 1870, speaking of short service, said:—"I hope for better "things. I look forward to seeing the broad line of demarcation between the "Army and civil life somewhat diminished. . . . . We think this "engagement, from its nature, will be the means, if it succeed at all, of drawing "into the Army a large number of men who, otherwise, would never join it. To "those who say we shall not get recruits under our new plan . . . . . I say, "'You and I are talking of two different persons. You are speaking of the man "'who now joins the Army . . . . . but I speak of the man who does not "'now join the Army, but whom we wish to induce to join it; of the young man "'who is reluctant to spend all his life away from his own village—who may wish "'to contract marriage.' . . . . . There must be inducements for these to "enter the Army, for they do not enter it now."

Now, Sir, have these promises been, in any sense, fulfilled? Has Lord Cardwell's system succeeded in attracting into the ranks of the Army large numbers of men of a class superior to those heretofore entering it? We have had statements in abundance to prove that they have not. We have the statements of facts carefully collected and laid before the public by Mr. Holms; we have had the statements of facts collected and the arguments laid before us by Captain Hime, the author of the essay under discussion, collected in a manner so able as to have obtained for him the high distinction of the blue riband of this Institution, which prove to conviction that Lord Cardwell's system has entirely failed either to improve the quality or to increase the quantity of recruits; but, further than that, we have evidence to show that the men who are now joining the Army, if they differ at all in quality from those who formerly joined it, certainly differ for the worse. In a speech, the importance of which it is impossible to overstate, made by the Secretary of State for War this year, Mr. Hardy said, "It must be admitted the Army is "not recruited from that class of men which my predecessor hoped would come "into it." Those words emphatically and entirely condemn the system which at present obtains. I think it may be taken as established that that system is, for the supply of recruits to the Army, in sufficient numbers and of suitable quality, an absolute failure.

I now propose to examine whether the failure is from defects which are inherent in a voluntary short service system as such, or whether they are defects which might have been avoided. In examining that system, it at once appears that the failure has arisen from an attempt to apply to home service, and to foreign service, one and the same species of enlistment, and the same terms of engagement. That attempt has resulted in the adoption of the "six years'" service, which is at once too short for the Indian service and too long for the home service, which, in fact, is neither fish, flesh, nor good red herring. I think it is transparently evident that the attempt to apply this to two services so utterly different in their requirements, must lead to inevitable failure. That being the case, I again find myself in agreement with Captain Hime, as to the necessity of making separate and distinct provision

for Indian and home service. I say it is absolutely necessary to engage men for each on distinctly different terms: for the Indian service men must be engaged for a comparatively long period of continuous service, whilst for home service we may apply, in the fullest meaning of the word, a short service system. For Indian service, it is self-evident that a six years' engagement is entirely too short. The great majority of men enlist at about eighteen years of age. There are strong objections to sending those men to India till they have become matured, and I believe that, as a matter of fact, they are not sent out till they are twenty. There are, thus, two years gone out of their six years' engagement, and only four years remain to serve in India, from which there must be deducted the time consumed in their voyage out and home. That is a system of which the false economy is so evident that I need not further refer to it. And now I ask, why has Lord Cardwell's system failed in its application to the home service to do that which it promised, namely, to attract a better class of men, in sufficient numbers, into the Army? I think the failure to attract good men arises from these particulars:—first, the uncertainty as to the conditions of service to which a man commits himself when he takes the shilling. At present it is a complete leap in the dark; he cannot know whether he is to serve at home or abroad, or where abroad, or in what proportion at home or abroad his term of service will be spent. This element of uncertainty I consider to be the one which is, perhaps, the strongest deterrent of all to that better class we desire to attract to the ranks. We know that men can be found to engage for a long period of service, in a foreign country, if that period be a defined period; if they know how long they are engaged for, and where they are going to be sent. We know that, because the experience of previous enlistments, for the exclusive Indian service, has shown it. We also know that, on the other hand, there are men in abundance who would be prepared to join a home Army, but who would be deterred from doing so by a liability to go abroad. But for the men who are quite willing to commit themselves to a distinct term of engagement abroad we do not bid, neither do we bid for those who wish to stay at home. We do not bid for those who have any thought for the morrow, we only bid for the reckless and thriftless, for those who go into the Army as a final resource, and because they do not see their way to doing anything better—men absolutely and entirely without forethought. These are the men we bid for, and these are the men we get, and we do not like them when we have got them.

Then what is the remedy? Surely by offering distinct terms to both, a distinct engagement for a period comparatively long for India, and short for home; and I at once wish to say we can do that without in any way involving the necessity of reverting to the old system of two distinct Armies, for India and elsewhere, or disintegrating in any way the present system which obtains. The regimental system would not be in the slightest degree dislocated by the method I propose. Taking the infantry as being the least complex arm of the service, and therefore best suited for the purpose of illustration, what I propose could be effected by dividing each regiment into three battalions, the one to be a foreign battalion, and the remaining two, home battalions; let the home battalions be always quartered in Great Britain or Ireland, and let the foreign battalions be permanently stationed abroad; let the men enlist for these several battalions on distinct terms. For the foreign battalions, say for seven or ten years' continuous service; for the home battalions, men would enlist on terms to be hereafter described. Let the men being engaged for the several battalions be not interchangeable, as they now are. The Officers, on the other hand, being engaged for the regiment, and not for the battalions, would be interchangeable between the battalions of their regiments, and serve in each as required, according to roster and in regular rotation. This arrangement, I think, would dispose of the difficulty arising out of the requirements of foreign service. It would clear the ground, and enable us to apply to the home Army the short service system in its fullest sense.

Let me now describe the terms upon which the men ought to be enlisted for the home Army. I think these men ought to be engaged for a period of nine years, of which three should be passed with the colours, in order to form them into soldiers, and six should be passed in reserve, during which latter period they would still remain (not turned adrift into that inchoate mass called the Army Reserve), but

forming the reserve of their several regiments, still attached to their regiments, and belonging to them until the last day of their service; so that, should the Army require at any moment to be mobilised, these men would know, and exactly fall into their proper place in its organisation. As to the terms which we should offer to attract them to our service, they would be these:—for the three years' service, which would be their definite term of service with the colours, I should propose that the pay should be somewhat as it is at present, perhaps slightly enhanced, and that the main attraction held out should be a substantial reward in the shape of pay during the six years' period after they were made into finished soldiers, and were really valuable. If men could, by serving three years in the Army in the way I have proposed, secure for themselves a substantial reward, say of 7*s.* a-week, or £18 a-year, for every year of the six, I think that would be sufficient to attract men into the Army who now do not enter it. I think we could fairly go down into the market, and bid for the best of unskilled labourers and the pick of the agricultural population; and those are the men we want. We cannot bid for the skilled artisans, they are too costly for us. This would obviate at once the necessity for our seeking in highways and byeways for recruits. We might, I think, withdraw the whole of our recruiting staff, and trust to the offer of fair market terms to secure an adequate supply of recruits. As soon as this system had been three years in operation, our very best advertisements would be the men I have spoken of—the Reserve men—with 7*s.* a-week in their pockets. An unskilled labourer, who found he could earn for six years 7*s.* a-week on those terms, would be a standing advertisement which would attract men in any number into the Army. We should then be able to pick and choose our recruits, and not being under the necessity of taking everyone who chose to offer himself, and who measures a certain number of feet in height, and a certain number of inches round, we should be able to reject the morally halt, lame, and blind. The corner would be turned, and men who are now deterred from our service by knowing the low class of comrades they would find there, would then be attracted to that service by knowing that they would find in the ranks respectable men of their own class and standing.

There is one thing which is absolutely essential for the working out of this system, and I shall endeavour to state it as shortly as possible. I have said—if we are to rely upon men in the reserve, we must not only know that they are there, but we must rapidly and immediately be able to lay our hands upon them, and they must be able to return in a very few hours to the regiment to which they belong. That brings us to the necessity of not only keeping the home battalions at home, but also keeping them within a certain defined locality at home; not essentially of narrow limits, not a town, not even a county, but a group of counties, and, in fact, it brings us at once to localisation and the formation of army corps. That is an essential to the scheme I propose, because it is absolutely essential that the men who are in the Reserve, and the regiments to which they belong, and of which they form the reserve, should be near each other, and that can alone be secured by keeping groups of regiments within military districts. I am afraid, in attempting to condense my remarks, I have not clearly explained my proposition; at the same time I hope I have said enough to induce those who hear me to believe, that of which I am convinced, viz., that we have by no means exhausted in this country the voluntary short service system; that we simply have to apply that system thoroughly as it would be applied by a man who was convinced of its merits, and had the courage of his convictions. Its admitted failure, I venture to say, is by no means inherent in the scheme itself, it is simply from the mode of its application. I am myself convinced that if it were properly and efficiently applied, it would be utterly unnecessary, as I believe it is absolutely impossible in this country, to have recourse to conscription.

Lieutenant CHAMPION, R.M.L.I.: As I joined in the competition for the gold medal, perhaps I may be allowed to make a few remarks upon the grave question that is before the meeting, especially as I took an adverse view to that taken by Captain Hime. The idea, Sir, forces itself upon me, that if the proposals of Captain Hime were applied to this country, however necessary, they would be looked upon as a national calamity, and this compels me to rise in support of a tottering voluntary system on which, in a very brief essay, I have treated. I stand at a disadvantage

in two ways. First, it is easier to attack than to defend a system that is falling in military estimation, and that has heretofore failed to perform that which has been required of it; and, in the second place, in common with others, I have been beaten in the contest. With regard to the first, although I find difficulty in dealing with it, yet I am not disposed to desert it; and with regard to the second, inspired by that courage with which Louis was animated when he fought at Dame Europa's school—I cry, "*Vive la guerre!*" and rush, but I trust not blindly, at my foe. But then, Sir, I can hardly look upon a contest of this kind in any other light than that of a simple duty, because we ran side by side rather in a common cause to obtain a result that might prove an advantage to this country. At the last discussion, while the majority of the speakers imparted to us much important information, they appeared to depart from the main subject before us, which was the question of "Conscription *versus* Voluntary Service," as proposed in Captain Hime's pamphlet. To show conclusively that conscription, and conscription alone, would satisfy all the requirements of the country, is *the* great task, and very ably has the gallant Officer attempted it. I understood Captain Hime to say, that he did not *like* conscription, but that he considered it was inevitable. Now, Sir, I would like to ask when this eventuality is to take place, and in how many years would conscription become a positive necessity. If conscription is alleged to be inevitable, then I maintain that that statement is a prophecy , and all prophecies should be received with caution. It appears to me we must be convinced first of all that the voluntary system, when properly applied, has failed, and, in fact, that it will place the country, if we continue to make use of it, in a very dangerous position, and that conscription alone will save and protect her. If conscription is to be received by the country we should receive it at once, and put it immediately into operation; but if, on the other hand, it is not necessary to introduce this conscription, I presume we have time to talk about it. I join issue with Captain Hime on one great point, and it is the point from which both of us must start, namely, that the voluntary system has been shown, *when properly applied*, to have failed. I maintain that throughout all his remarks, and multitude of quotations, he has never once shown that the voluntary system, when it has been properly applied, has failed. If Captain Hime has failed to do this, I think conscription may hide its dragon-head until some immediate national necessity calls it to our aid. I do not at all agree to some of the proposals with regard to supplying the ranks of the Army with volunteers from the militia. The proposals that were made last Friday, and that seemed to me to meet with general approval from the meeting, I look upon as unwise, because if you rob your militia service of its men, you naturally weaken the great territorial reserve; and you not only do this, but you also destroy that interest which it is absolutely necessary Officers shoul dtake in the instruction of their men, and you very seriously impair the efficiency of that service. I do not mean to say it would take very much to impair the efficiency of the militia service, but that is not the fault of the Officers. Whose fault it is, it is not my place to state, but if the militia were founded on the very finest system in the world, if you were to rob it of its men, and draught them into the Army, you would materially destroy its efficiency. If any thing will induce men to join the Army at all, they will join it at once. I suppose the object of serving with the militia is to remain at home; and here again I join issue with Captain Hime, that the Army should have its foreign service character destroyed. I beg to point out that a similar system with regard to the English Army in India has done and is doing incalculable damage. Men are draughted from regiments to fill the ranks there, a proceeding which is not only destroying the *esprit de corps*, but is giving Officers great cause of complaint. If conscription is to be accepted, further discussion in favour of the voluntary service may be dispensed with; but if we can deal with the difficulties, conscription need not be accepted. The great difficulty we have to contend with in voluntary service is, that that system compels us to lengthen the term of service to that extent that will make it worth our while to give soldiers a pension for serving; and, on the other hand, make the pension worth the soldier's while to serve for it. If in Germany they had to contend with a voluntary system like we have, with all their military excellence they would be just as much embarrassed as we are, and more so. If the nation is willing to pay for the privilege of maintaining an army on the

voluntary principle, I think by all means she ought to be permitted to do so. We are a very great and rich nation, and I consider that whatever little extra necessary pressure was put upon us, it would not very seriously be felt, and if the Army could be only made to produce the results required on the voluntary principle, I think the nation might bear the expense. In the system which Captain Hime has proposed one matter attracted my attention. He says there should be a judicious system of exemption. Now, in Great Britain, I maintain that would be a very serious matter. I do not think it would be very well received. We are a peculiar people; we have rights and liberties, and all that sort of thing, and we like to hold on to them, and if we made invidious distinctions, he would be a brave man and able, who attempted to grapple with the difficulty. I cannot give Captain Hime credit for ignorance of that jealousy with which every Englishman, from the highest to the lowest, regards his personal liberty. If his suggestion is to be carried out, you would have invidious distinctions, and it would be as well to try and avoid a system that would introduce such a disagreeable law as that. There have been three great mistakes made with respect to the voluntary system. We have forgotten to make service in the reserves compulsory, except in the case of the old pensioners, and really I do not think that that force is worth thinking of in a question of this kind. Secondly, we have failed to consider the services of men of ten and fifteen years' service as of any value; and we have, thirdly, failed to look upon service in the reserves as worthy of any increased pension. I consider that these three things are very important. They may be little details, but it is upon a perfection of details that the whole military machine depends; and I suppose nothing would induce men in the labour market to join the Army more than proper pensions being given for ten, fifteen, and twenty years' service, while service in the reserve should, if made compulsory, receive its due reward in the shape of increased pensions. The system I proposed, was that there should be three periods of service, ten, fifteen, and twenty years, with three reserves, corresponding with those three periods, and five years' service required in each of the reserves; that you should demand from every man twenty-five years' service to the State; that a man who left the Army at ten years should go to the first, then to the second, then to the third reserve, and so complete his twenty-five years' service. That a man who completed his fifteen years should go to the second, then to the third reserve, and complete his twenty-five years' service; that a man should, who completed his twenty years, go to the third reserve; and then, about his business, having completed twenty-five years' service. I show by my scheme, roughly, that I would in five years produce a reserve army of about 55,000 men, or between that and 60,000 men, supposing the English Army of course is kept at its usual strength of 200,000 men. In ten years it would be considerably more, and in fifteen years a reserve of at least 130,000 or 140,000 men would be at the disposal of the Army in case of war. As this is a matter which does not directly affect my own profession, I ought perhaps to make an apology for handling it; but, Sir, few Officers have the opportunities of ascertaining the wants of two great professions more correctly than the Officers of the Royal Marines; we know them both; we understand their differences, and we know what one could gain from the other which would add materially to the advantage of each. Therefore, perhaps, I may be pardoned for making some remarks on a subject which does not directly affect my own profession. As a soldier, I have no politics, but there is one question I would ask, and I do so with all due respect; it is a question which must be decided before any Officer can form an idea of what is required at the hands of our Army. Sir, is it the intention of Great Britain to uphold her treaties and foreign obligations to the last shilling in her exchequer, and the last man in her ranks? If so, then I think from the present aspect of Europe, the sooner conscription is put into operation the better; but if, on the other hand, we are spared a few years of peace, and can rely upon it, and that international courts of arbitration will be found to perform satisfactorily the duties we require of them, then, Sir, I will express the hope that the improved voluntary system may be adopted; but all these matters being in the hands of able ministers, as soldiers it is our duty to await their decision.

Colonel Leahy, R.E.: It is now over eight years since the subject of recruiting became a public question of great importance, and it is very much to be regretted

that there is no general concurrence of opinion as to the course we ought to adopt to fill up the ranks of our Army. This, I believe, arises from the fact that there is no precise and authoritative statement as to the objects and duties which the British Army is intended to fulfil.

A consideration of the "varied duties of the British Army in peace and war," would, in itself, be subject for an essay. Those duties cannot be considered apart from the duties of the Navy, which has been, and ever will be, the first line of defence for this country. I, therefore, think it is to be regretted that some intimation of the duties expected of the Army, and of the principles on which it ought to be recruited, was not given for the guidance of intending essayists. Had that been done, I think we might possibly have been brought to more general agreement as to the mode of filling up the ranks of the Army.

Captain Hime truly says the question of life-service as distinct from limited service is a political one. It has, however, been laid down by Parliament that the Army shall be modelled on the principle of short service, which was held by Lord Cardwell to be at the very root of army reform; and, if our discussions are to be of any use, they must be directed to considering in what way the requirements of the country, as laid down by Parliament, can best be met.

Captain Hime says that "universal conscription, without substitution or dotation," is the "best means" and the "only means" of "providing recruits and for forming "reserves for the British Army;" and he sets forth a valuable collection of facts, quotations, and arguments to prove his case.

Sir Lintorn Simmons has, I think, disposed of most of the arguments; but there is one fact that Mr. Holms mentioned which I think renders a discussion on conscription futile, namely, that a proposal for a conscription would not be entertained in Parliament. So long as that is so, it is no use for us to discuss it. Our object should therefore be to consider how men in sufficient numbers may be induced to join the Army and its reserves "on the same prudential grounds that they adopt "any other profession or calling," and to arrive at "this stage of civilization" without excessive or wasteful expenditure.[1]

While, therefore, I entirely differ from the conclusions at which Sir Edward Warde and Captain Hime have respectively arrived, I can support many of the professional points on which they have given us the benefit of their experience and opinion.

In the first place I am able, confidently, to support the conclusion at which Captain Hime arrives, that if the system of short service be carried out with a will, recruits, representing the average intelligence of our industrial classes, may be thoroughly instructed in all the duties of an infantry soldier in about one year. This opinion is formed after experience of the last three years, during which time over 1,200 recruits for my own corps[2] have received great part of their training under my personal superintendence; while, during the same time, about 800 line soldiers have also received special instruction under my immediate direction.

I therefore feel confident that in one year recruits may be instructed in their duties, and that one or two summers of subsequent residence in camp, with attendance at autumn manœuvres, would complete their training as soldiers; so that, provided they were physically fit, and were immediately commanded by the Officers with whom they would be likely to be associated in service, they would then be thoroughly efficient to take their places in a field army.

I may here observe that, having during the last summer been present with a force comprising detachments from five different army corps of the German Army, I found that there were very few private soldiers in the ranks who had completed two years' service. The men in their third year of service were almost invariably employed on some regimental special employment, or in some few cases they

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[1] Prize Essay, page 12.

[2] The time actually taken for training as infantry and engineer soldiers the recruits for the Royal Engineers, averages about 18 months. During 12 of these months the men are employed for four days a-week on technical instruction or at their trades.

were non-commissioned Officers. They were, of course, all over twenty years of age.

I would here repeat what I have, on former[1] occasions, strongly insisted upon, viz., that short service to be successful must be really short service. The service at home required to train the soldier for his duty would extend over three years, but that three years may comprise a considerable time devoted to industrial training. I will not take up your time by going through the details of the proposals[2] I have made; but the views I have set forth on army reform are almost identical with those which Colonel Cox has now put forward as his.

Reading from a paper printed April 26, 1867, I then suggested:—

1. The division of the period of the service of the regular soldier into three classes, viz.:—Service at home, service in India or the colonies, and service with the reserve forces.

2. The regimental organisation to be such that each regiment should contain a proportion of each of the three classes above enumerated.

3. The extension of the system of reserves to those colonies which are supposed to contribute men for their own defence.

I conceived that under these proposals it was possible to render the service attractive to a superior class of men to those who then enlisted, and to make dismissal from the ranks a real punishment. I then proceeded to define the period of service in India and the several colonies, adapting it to the climate and so forth.

I believe with Lieutenant Colonel Cox and other speakers, the dissatisfaction created by the existing arrangements to be in no small degree due to the attempt to combine short service commencing at 18 years of age, with an engagement for limited service in India and the colonies, an employment which should be provided for by a separate voluntary engagement for long service.

The full development of the regimental system is, I think, essential, and each regiment should consist of two or more battalions. The establishment of a regiment should include not only the trained men with the colours and the men under instruction, but also those able-bodied men who, having passed through the ranks, are held in reserve to fill up those ranks, in case the regiment should be called upon for service.

To carry this out, the recruiting should take place for particular regiments, and the regimental reserves should be under the control of the Colonel commanding the regiment.

The numbers under training, and the numbers of trained soldiers present with the colours, might vary with the exigencies of each year; but the establishments of our Army should, after due deliberation, be laid down once for all, and it should not be within the power of the Minister of War for the day, to prepare annual Army Estimates based on a variation from those establishments, without first taking a formal vote of Parliament on the subject.

In order to keep up our Army at its present strength, the numbers to be annually trained in the head-quarters of each double battalion regiment should, at the present time, be somewhat about 300. Of those, 100 would be required to meet the demands for permanent service in India or the colonies, or as non-commissioned Officers. The remaining 200 should be remitted to the reserves; and there should be a discretion given to the Officers commanding the regiments as to which reserve the men should go to. There should be "Regimental Reserve" men required to fill up the regiment, the "Militia Reserve," and the "Volunteer Reserve," and inducements must be offered accordingly. A soldier who had served satisfactorily in the regiment should, within the limits of approved numbers, have an option as to which reserve he would go into.

The next point of importance is the necessity for good non-commissioned Officers, to whom suitable pay should be given. On this point I entirely agree with Sir Edward Warde who says—"They are the connecting links between the Officers and

[1] Vol. xiii. pages 177 and 495, } Journal of Royal United Service
Vol. xv. page 307, } Institution.

[2] See papers read at Royal United Service Institution, April, 1868, and February, 1871, vols. xii. and xv. of Journal of the Royal United Service Institution.

"men, and it would be impossible to maintain a high state of efficiency and discipline "without having in these positions men of high moral character, and rather more "than the average ability." Now I have had personal experience of this in the training of recruits, for, at the School of Military Engineering, we train about 400 recruits a-year. For the technical training of these recruits a non-commissioned Officer, selected with the greatest care for his military and professional qualities, is made a Staff-Sergeant Instructor. This non-commissioned Officer takes about 40 men through the course of instruction, and for about a year they are under his influence, and I find that the character of the non-commissioned Officer reflects itself in that of the men whom he has trained.

As a means of attracting men to the ranks, and providing a contented and efficient reserve who would act as recruiting agents, we must not only pay the market value of the class of labour we desire to obtain in the ranks of the Army, but we must liberally pay the reserves, and especially the regimental reserves.

It is, however, most necessary that for men engaged to serve on a contingency there should be a prospective pecuniary inducement to appear when required. This I would offer in the shape of pensions to commence at 50 years of age, with power in certain cases to the men to commute by anticipation their prospective pensions. I believe the effect of a pension is, in the case of the class of men we wish to attract to the ranks, very great. Dockyard workmen accept lower rates of wages, with the knowledge that they will be pensioned when disabled: and I think that every man who has served faithfully in the Army and its reserves, should have a claim to a prospective pension, with power to commute that pension in certain exceptional cases, such as the case of a man wishing to emigrate.

It may be objected that the expense of this arrangement would be so great as to debar its adoption; but that is not so. The cost of short service with pensions, as compared with long service with pensions, is very fully given in papers that I read in this Institution in 1868 and 1871. The correctness of those calculations may be easily tested, and I refer to those papers for my views on points of detail which cannot now be entered into.

No project for finding recruits can be considered complete, in which the cost has not been taken into consideration, and I entirely dissent from Captain Hime's assumption that the "flower of our population" could be conscripted into the Army at about one-third the cost of the present Army. Indeed, I doubt whether, were conscription possible, the cost man per man would be so little as we now pay.

Under existing arrangements, the cost of each volunteer, who receives neither pay nor pension is about £2 per annum, while the cost of militiamen, who serve without pension, is £6; the cost of a reserve soldier is something more, and the cost of a line soldier, including pension, was, as shown in the appendix to the Prize Essay, about £40 in 1868. (I am unable to reconcile this latter fact with Captain Hime's statement that we are now paying £100 a-year for the "dregs of the community.") The annual cost of a volunteer who had served in the ranks of his regiment, including the cost of his prospective pension, would not exceed the present annual cost of a militiaman; yet I am sure such a volunteer would be worth more than one of the militia boys who have been referred to. The annual cost of a militia soldier, who had served in a regiment, would be about double the present cost of a militiaman, and that of a regimental reserve soldier would be about three times the cost of our present militia reserve soldier, including in each case, the cost of pensions. I believe payments on this scale would attract recruits, who would afterwards join the reserve; and, taking into consideration the fact that provision for pension would be provided concurrently with their service, I do not think the cost would exceed that which we are now paying for the Army, and for pensions on the old limited service principle.

I think if the pensions were thus treated as annuities (like post office annuities), the issuing thereof could be transferred to a civil department of the Government, and there would be more chance of pensioners being engaged in suitable civil employment.

I entirely dissent from the idea that the Officers would prefer their present inactive life to one of responsible duties and command. I think it must be most irksome to Officers of regiments to be obliged to turn out for duty with the present

skeleton companies. They would be only too glad to be assigned other responsible employments, in directing the industrial employment of their men, and in managing the Reserves.

I may here say that I believe, by proper arrangement for the industrial employment of the men, the wages of the soldier might be very largely augmented, without increasing the charges in the Army Estimates.

The CHAIRMAN: I think it would be better for this meeting to understand, from Colonel Leahy, more precisely what he means in regard to pensions. He mentioned giving a pension to every man of the age of fifty. I want to know whether a man who has been two or three years in the Service and leaves the Army is, at a subsequent time, when he attains the age of fifty, to have a pension?

Colonel LEAHY: I mean that a man should be liable to serve, up to the age of fifty, in one of the classes I have enumerated, receiving, while serving, the emoluments of the corresponding service or Reserve. If he does not fulfil his engagement, he would not be entitled to his pension; but, if at any period of his service, he wished to anticipate his pension, having fulfiled his engagement up to that time, he might commute his claims to a prospective pension.[1]

Mr. CLIFFORD E. WALTON, Deputy-Assistant Commissary-General: I am one of the defeated candidates for the gold medal so deservedly carried off by Captain Hime, and I mention this fact as giving me some claim upon your attention, because it is some guarantee that I must have devoted myself to the study of the subject. You are aware that certain distinguished members of the Council most kindly volunteered to devote their time to the somewhat invidious task of selecting the successful essay, and, I think, however highly placed above our criticism they may be, it must prove a satisfaction to them to know that even the vanity of defeated essayists can concur most cordially in the justice of their award. Without, for one moment, pretending to place my own judgment on a par with that of those who have so kindly acted as our umpires, I do honestly say that, notwithstanding all the proverbial partiality of an author for his own productions, I acknowledgé, with pleasure, the discrimination and justice of their decision, so far as my own essay is concerned. Still you will not think, because I am a defeated essayist, I should therefore be precluded from taking part in this discussion. I by no means think Captain Hime's essay faultless, if it is to be regarded as a final and practicable solution of the question now before us. Permit me to confine myself to the point at issue, by submitting to you the details in which, I think, the two essays that we have heard on the subject are radically and essentially faulty.

First, with regard to Major-General Sir Edward Warde's lecture. It does not appear to exhibit, in any way, either the estimated strength of the serving men or of the trained soldier reserves, or the estimated cost of that strength. However valuable, therefore, such a paper may be and must be, coming from an Officer of such standing and weight, as containing his opinions and experiences upon certain points, I must submit to you that, as a definite solution of this vexed question, it does not afford much practical aid to the legislator or to the political economist. There are one or two points in that paper on which I should like to throw the light of past history, such as the promotion and punishment of non-commissioned Officers. We have only to look back comparatively a few years to find its solution; but these, after all, are very minor and collateral details in any grand and comprehensive scheme for obtaining men, in sufficient numbers, for the defence of this country. I submit that any scheme to be now adopted must be thoroughly comprehensive, if it is to be of any avail whatever, in view of the enormous reserves of *trained soldiers* at the disposal of each one of the other great Powers. When we limit ourselves to the discussion of such matters as a few pence more or less of pay per day, and the promotion and punishment of non-commissioned Officers, or the disposal of soldiers in Government appointments after their service, it does seem to me as if we were trying to stop a huge and alarming leak in our national ship with a wretched single cork; and when I hear so many distinguished Officers, both in speech and print,

[1] The cost of pensions and the value of prospective interests therein, can readily be calculated from the annuity tables in the "Postal Guide."

proposing to solve the question of our very existence as a nation by such expedients as shall serve merely to stave off current desertion, or to fill the vacancies on our petty existing establishment, it seems hopeless to induce the civilian population to appreciate rightly the utter insignificance of what we are pleased to call our Army. Some of these expedients seem to me to reduce themselves to such *reductio ad absurdum* as this:—One Englishman, thoroughly trained, on his present pay, is equal to more than one foreigner, *ergo* if you pay him double, he will be equal to two foreigners; if you pay him treble, he will be equal to three foreigners, and so on, *ad infinitum*. I should imagine that the only regret of our soldiers to such a scheme, when called upon to meet 2,000,000 of Germans or Frenchmen, would be that they cannot carry these advantages into the next world with them. I would suggest to those gentlemen who advocate entire reliance on the voluntary system, that they should first sit down and carefully compile statistical statements, showing the number of trained soldiers at the disposal of each of the other great Powers, and the number of trained soldiers they feel certain of being able to give us, even if all their expensive suggestions as to increased pay, &c., were adopted; for I maintain that, if we had no deserters, and fifty applicant recruits for every vacancy on our existing establishment, we should not be one whit nearer an efficient Army as compared with other nations. Captain Hime has so very ably gone into the history of past measures, that is is needless for me to do more than say that, so far as he has gone, he has climbed the same historical ladder as myself, and arrived at the same conclusion. It is time, I think, that we hear somebody on the side of Conscription; for clearly, if we wish to remain a power in Europe, or an independent people at all, we must march with the times—we must follow the initiative already set by our neighbours, and must adopt manhood service (*i.e.*, a passage through the ranks of every youth on arrival at the age of manhood). I may here remind the objectors to conscription that, in our last European war—the Russian war—a war which was of only two years' duration, and of no comparison, in point of magnitude and numbers engaged and rapidity, with later wars—we were obliged to adopt that very conscription which they assure us that the English people would not even now tolerate, when every day even the most prejudiced student of military politics is becoming more and more reconciled to its necessity. But, although I agree with Captain Hime that we need conscription, he must permit me to observe, he has not even attempted to solve the great problem into which this great question of recruiting must resolve itself, namely, the problem of the reconcilement of the two antagonistic elements of *men* and *money*. It is all very well for a physician to prescribe to a poor patient plenty of cod-liver oil, port wine, abundance of cream, and other expensive delicacies—the prescription may be most excellent in the abstract, but if a man cannot afford to carry it out, it is of very little practical use to him. Again, Captain Hime seems to me to propose an exceedingly limited conscription at first. I believe nothing would sooner conduce to the speedy repeal of a Conscription Act than the dissatisfaction caused by such partial action at first. If we put every man in the same boat, very few will be unmanly enough to grumble; but if 10,000 or 20,000 are to be selected from 150,000, the outcry will be great.

Captain HIME: I spoke of an unlimited or universal conscription.

Mr. WALTON: Limited, in the first few years, by taking a few men by lot.

Captain HIME: It depends upon the sense of the words.

Mr. WALTON: And, with regard to the other proposals that we have had with respect to the Reserves, let me remind you that, if every youth in this country, without exception, were compelled to pass through the line on arriving at the age of manhood, we should still be four years before we should be in possession of a reserve of even so little as half-a-million of men, and the other principal European nations have two millions at this moment. The great deficiency in Captain Hime's essay is his ignoring the question of expense. I think, too, he has failed to give us an immediate Reserve—remember, gentlemen, that nations now-a-days are wrecked in *six weeks*—an immediate Reserve of trained soldiers; and by "trained soldiers" I do not mean a rabble of raw militia lads, however excellent material they may be, with arms in their hands; and I do not mean a high spirited, devoted, and patriotic, but only half-disciplined body of civilian volunteers; I mean trained

soldiers; men who have passed through the regular service, and have been thoroughly taught, and who have subsequently been compelled to keep up their knowledge and discipline by regularly recurring drills and trainings, more or less frequent in proportion to their previous regular service. I do not agree with the foreigner who said our volunteers were a "harmless joke." I do not think any institution which induces the people of this country to believe that they possess so many thousands more reliable, trained soldiers ready to take their place in the ranks than they actually do possess, can be harmless. Surely, when all the other great Powers are enabling themselves to place in the field, at a *week's* notice, from *one to two millions* of thoroughly trained soldiers (and we have heard from the last speaker that they are thoroughly trained, although young soldiers), it is too late for us to occupy our time in discussing such a miserable stop-gap as the acquisition of 10,000 or 12,000 additional recruits in a year, or the hindrance of the desertion of some 3,000 or 4,000 unwilling soldiers. We are met here to discuss, not the individual wellbeing of the soldiers now serving, however important that may be in itself, but the public requirements of our country in case of menace. I submit to you, then, that the requirement of the times is this—the acquisition of a very small, or comparatively small, but highly perfect regular force, with immense power of instant expansion, that is, with unlimited reserves of trained soldiers—and the difficulties in the way of this requirement would be, first, the financial difficulty—the money difficulty—and afterwards the political, social, and mercantile difficulty. With every admiration for Captain Hime's essay, I do submit that he has not met this requirement, and has not grappled with these difficulties, so as to afford any real aid in their solution. Even if my time would allow, it would ill become me now to inflict upon you the proposals contained in my own essay, but one point I desire to impress upon my audience—that it is absolutely necessary that we should withdraw the public mind from dwelling upon the supply of a limited number of raw recruits annually, in order to force it to concentrate itself upon the question of unlimited reserves of trained soldiers. Therein, and therein alone, appears to me to lie the whole question of an efficient or an inefficient Army, as Armies go now-a-days. It is said, the country is not ripe for manhood service; but I do urge you to perform the manifest duty of such an Institution as this, by *leading* public opinion on military and naval affairs, and not by merely following the dictates of those who would be the first to blame the leading members of this Institution if disaster should ever occur. I may have spoken plainly, but I hope not discourteously. I hope plain speaking may be encouraged in this Institution, and the speaking also of young Officers like myself, as well as of those older Officers from whom we come here to learn, so long as that speech is consistent with the speech of Officers and Gentlemen, so that we may compel outsiders to listen to the warnings of this Institution and to profit by its advice. I maintain myself that there are devices by which manhood service could be carried without delay into effect, without detriment to the mercantile or productive interest, and without any great increase to the general taxation; but, as our Army is now, it really does seem as though the old Roman proverb was daily becoming more and more applicable, sadly and prophetically applicable, to our own country, "*Quos Deus vult perdere, prius dementat.*" The main problem of the reconcilement of the two antagonistic elements of men and money has, I submit to you, not yet been solved, and, so long as that reconcilement is not effected, the problem will remain unsolved.

Major WETHERED, Paymaster, R.A.: I was not a competitor for the gold medal for two reasons; because I had not studied the subject sufficiently to feel qualified to enter the lists, and because I have not been associated sufficiently with the fighting force of the Army to speak with any authority. However, I was deeply interested in hearing the discussion on Friday, and last evening I read Captain Hime's able essay. He certainly in that essay proposes to take John Bull by the horns. It seems generally admitted that the noble animal is not prepared at present, certainly not without the red flag being waived much more closely to his vision, to undergo the yoke of military bondage, and therefore I think we should consider how far we can make better use of the existing voluntary system. I quite agree that this voluntary system has not been properly worked out. It has, in fact, not had a fair chance in any way. Our recruiting system is excessively faulty from beginning to end. When

the recruits join, we do not make the Army as popular to them as we should. We do not seek to make them as contented as we ought to do. We subject them to a great deal that might be avoided. Our non-commissioned staff is nothing like what it should be. There is nothing to induce emulation amongst the men in the Army to attain to that rank. They are not at all the class of men we should have in any way. Sir Lintorn Simmons has given us very interesting details, and has evinced the labour and trouble he must have taken to arrive at these conclusions. As regards the cost that he has shown the country is put to, by enlisting lads from sixteen or seventeen up to twenty-one, he has omitted one or two points which rather strengthen his case, and show that they cost the country more than he laid down. For instance, if we take a soldier at sixteen, and he is not physically fit as a man for the duties required of him, we are not only paying him up to the age of twenty-one, but, taking that five years' service from his first term of twelve years, or twenty-one years in all, we lose five years efficient service; so that, instead of getting twenty-one years' service from a muscular man, before we allow him his pension, we only get seventeen years, and in the natural order of life he would draw his pension five years longer. It would appear to be a wise economy to pay men of twenty-one years or upwards, on enlistment, a higher rate of pay, and exact less service towards pension. Mr. Holms touched one very important point; that is, to relax the ordinary *régime* of the barrack-room. I think it would be a very great improvement. We treat soldiers very much like children. Every Officer knows how unpleasant it is if his superior is constantly harassing him about some little matter which does not interfere with the efficiency of the Service; and that is very much increased in the case of the men. If we knew the aggravation to which these men are sometimes subjected from an inferior class of non-commissioned Officers, we should have an idea to some extent why soldiers do not like the Army when they join it. Then, again, if soldiers in the "piping times of peace," have very little to do, why should not we give them the benefit of that ease? During their leisure hours could we not provide some means whereby they might learn some trade or handicraft, or some remunerative employment? The country would gain by it in the end, and the men would be turned out respectable members of society. Then, in the barrack-room, we might have many trifling comforts, but still great comforts to the men. For instance, why should not the men have a seat to sit down on instead of a form? A chair or a stool would be a great comfort to a man, for he cannot drag a form all over the place. Then a man has no place to put any of his personal property. Why should not every man have a small locker or shelf, where he could leave his property in security. A question was raised about not getting recruits, because we go into the labour market at a disadvantage. Though we do not bid for the soldier the same price that we are paying the labourer, yet the soldier has many advantages in the future which, to a certain extent, counterbalance the small amount of pay he receives on enlistment. I am quite certain that no man who is in any employment, and receiving a stated amount of pay, would think of entering the Army at a less rate of pay. The men who enter the service are generally those who are dissatisfied or discontented with their position in civil life. No doubt, with many of them "their character was so bad they could get no work, and so enlisted." Now, whatever may be the motive which induces men to enlist, I think, when we catch them, it is an advantage that we should take them off the country, and it is our interest to make the Army as pleasant as we can to them in every way, and to make them content with it. Here it is that our faulty enlistment at once breaks down. We send out recruiting parties, and their object is to cajole every man they can into enlistment, for the sake of the reward we give them for bringing these men in. A soldier comes—he is sworn in, and bound for a certain number of years. He joins his regiment or depôt, and finds things are not exactly what he thought they would be. He goes for his pay, and expects to get his shilling; but finds that, instead of getting a shilling a-day, as he expects, he does not receive sixpence. The recruit is liable to a great many stoppages out of his pay, so that it is reduced from a shilling perhaps to three pence. Then, when you come to his rations—he does not get a sufficient quantity of meat. A man nominally gets three quarters of a pound of meat, but bone, and inferior cooking, reduces it 50 or 70 per cent.

Sir HARRY VERNEY: I ought hardly to intrude myself upon this meeting, when there are many Officers who have more and far more recent experience than myself upon the matter. I had the recruiting of the Grenadier Guards many years ago for six months, and I made it a great favour to admit a man into the regiment; therefore I had no difficulty at all in obtaining recruits. I think there are many improvements that might be recommended from this Institution to the Government, which would make recruiting for the Army more popular, and induce men of all classes to desire to enter the Service. I do not agree that there would be no advantage at all in giving little civilian offices, which fall to the disposal of the Government, to old soldiers.

Mr. WALTON: I did not say that; I only said it did not affect the question very much of a large reserve.

Sir HARRY VERNEY: I look upon it that it is the duty of the Government, when men have served in the Army and the Navy with credit to themselves, and left their service with a high character, always to give them such offices as are in their power to fill, as well as men who have not served the country. For instance, I was lately at Kew Gardens, where I used to see some old soldiers of the Rifle Brigade, but to my great regret I find that in place of them, the Metropolitan Police are now substituted. In Hyde Park, Metropolitan Police may be preferable, but in places like Kew Gardens I should think old soldiers as suitable. It has always appeared to me that we may introduce into the Army that system which in the Navy has become so very satisfactory, I mean the system of educating boys for the profession.

We all know that sailors who come from the "Britannia" have been among the very best sailors in our ships. Why should we not have an establishment in the New Forest, or Cannock Chase, or Dartmoor, for educating our young soldiers? I consider that every man who has been educated at the expense of the State, ought cheerfully to serve the State in the Navy or Army Reserve. I am in favour of such compulsion with regard to the militia, but of the voluntary system as to the Army, every lad who has been brought up either in a reformatory or in a workhouse ought at once to be drafted into the militia. As to another point, I may say, when recruiting, I never thought of refusing a man because he had a bad character with the parish constable, or even with the gamekeeper, though I never would admit a man who had been convicted of felony, or any disgraceful offence, or who had such a character that he would be injurious to the regiment. Many of those men who had a bad character from the constables, though nothing worse had ever been found against them, when enlisted, turned out after a time to be among our very best soldiers.

Brigadier-General Sir JOHN ADYE, R.A.: I am desirous of taking a small part in the present discussion, although aware that time will only admit of a short outline of my views. The subject under consideration is "the best mode of forming reserves "for the British Army." Before putting forward my proposals, let me shortly review the old conditions under which our soldiers served. Formerly the men were enlisted for unlimited service, and remained until incapacitated by age, wounds, or failure of health. In 1847 the system was introduced, which was, practically, one of 21 years' service with a life pension. It had many merits. The men were well trained, well known to their Officers, and for the most part in the prime of life; such was our Army when the Crimean war occurred. On the Queen's birthday of 1854 20,000 English soldiers marched past the Sultan at Constantinople on their way to the Crimea, men, in point of *physique*, discipline, and training, almost unrivalled. The battles which ensued proved their worth. They stormed the heights of Alma, exciting the highest admiration at their courage, and we must not forget that the distinguished General in the chair (Sir William Codrington), was one of the great leaders on that occasion. Again, at Inkerman, though faint, weary, and hungry, they stood for hours and held their position against great odds. But there is another side to the picture. The Army, though excellent in itself, had no Reserves. During the earlier periods of the campaign it began to diminish at the rate of 3,000 men a month. The Committee of the House of Commons, on the state of the Army before Sebastopol, say:—"At the date of the expedition to the East, no reserve was provided at home, adequate to the undertaking." Mr. Sidney Herbert states in his

memorandum of the 27th November—"The Army in the East has been created by "discounting the future; every regiment at home, or within reach, and not forming "part of the Army, has been robbed to complete it. The depôts of battalions under "Lord Raglan have been similarly treated. Again, the men sent out to reinforce the "Army were recruits, who had not yet become fit for foreign service, and the depôts at "home were too weak to feed the companies abroad. The order to attack Sebastopol "was sent to Lord Raglan on the 29th June. The formation of a reserve at Malta "was not determined upon until early in November. It will be seen from the corre-"spondence between Lord John Russell and Lord Aberdeen, that Lord Raglan had "reported that he wished he had been able to place in the position of Balaclava, on "the 26th of October, a more considerable force; and also that, on the 5th Novem-"ber, the heights of Inkermann were defended by no more than 8,000 British "infantry." "When the Duke of Newcastle acquainted Lord Raglan that he had "2,000 recruits to send him, he replied that those last sent were so young and "unformed, that they fell victims to disease, and were swept away like flies; he "preferred to wait." These words of Lord Raglan show how quickly the Army had fallen into great difficulties from want of reserves, and for months it dwindled away in front of the enemy, and England in great grief had no adequate means of reinforcing its shattered ranks. When the war terminated we had actually buried 21,000 men. Such is an Army of old soldiers and no reserves. It can fight a few battles, but is not fit for a prolonged campaign. Surely it is apparent that we must devise a system which will enable us to maintain our strength in a lengthened war. Every nation has studied this question, and has decided on a principle of short service and reserves. The gallant Officer, Captain Hime, who has gained the gold medal of the Institution for his essay on this subject, attempts to prove that rigid conscription is the only solution. No doubt a first rate Army can thus be obtained? but is the country aware of, and prepared for, the inevitable sacrifices of such a plan? Are the merchants with their own sons, foremen, managers, mechanics, and work-men, ready to serve three years, to be drilled incessantly, and be then sent into reserve? Are they prepared to place military requirements first and commercial last? We should have a magnificent Army, the country would be safe, and the estimates would rapidly diminish, because men, taken regardless of market-value and without pensions, would cause a great saving. But look at the other side, and do not forget that the Estimates would not show the real cost of the Army, because trade and commerce would be paralyzed, especially in time of war. The Continental Powers feel compelled to adopt this plan, because they are in close proximity to other nations equally powerful, and the frontier between them is a mere line drawn on the map. But even with them the system is becoming perfectly unbearable; and, in some cases, thousands are leaving their country to escape it. Our circumstances are different, and I have not yet observed any symptoms leading me to believe that the people are prepared to adopt conscription. What, then, it may be asked is the solution of our difficulty? Two great measures have been recently introduced: the one localization, the other, the partial introduction of short service, which seem to give great promise of success. As regards the first, our regiments have hitherto had county titles, but no county ties. They have had small moveable depôts and indis-criminate recruiting. For years past, military men have advocated the principle of localization, and at length the system is about to be tried. The depôts are being permanently fixed in their own districts, county associations will be formed, which will stimulate recruiting and popularize the Army, and which will ultimately lead to a fusion of the militia and the line. I hope ere long to see the militia and the line battalions blended into one, the former for home and latter for foreign service, the Officers and non-commissioned Officers becoming interchangeable. Such are the hopes of successful localization. The other change, that of short service, is, if possible still more important. It is evident that the duties consequent on our Indian and Colonial possessions do not admit of an absolute system of short service—but we may let the two run concurrently—that is, maintain a proportion of men for short service and reserve, and the other with long service and pensions as of old. Surely these great measures which are now being introduced, are worthy of a trial. It is said, however, that our recruits are falling off in every respect, and that men will not enlist for short service. My own experience does not bear out this view.

Having commanded the Brigade Depôt of the Artillery for some years with two or three thousand recruits under my command annually, I found them to be of the same class as had always enlisted, and I could desire no better. Let me, however, quote the opinion of the Inspectors-General of Recruiting. General Edwards, writing in January, 1873, after stating that the number of recruits in the past five years amounted to 92,456, adds—"It will be seen that the number of recruits fully "equalled the demand, and that the inducements to enter the service during the last "five years have been sufficient." Again, he says—"The autumn manœuvres of "1871 and 1872 have elicited the fact that the *physique* of the Royal Artillery and "Cavalry have been such as to excite unqualified approbation; and, by a careful "observer it has been remarked, that the nation may be assured that the Infantry "are such as could be desired, and have maintained their long-established character "of efficiency." Again, General Taylor, the Inspector-General, in January, 1874, writes—"Although there is thus shown a slight diminution in the number of "recruits raised during the past year, yet that number has been sufficient to keep up "the Army at large to its establishment as authorised by Parliament, and there is little "doubt but that a larger number might have been obtained, had the requirements of "the service called for an increased supply; for, in many sub-districts, recruiting for "some portion of the year was almost entirely closed." Again—"The quality of "the recruits raised during the year may be considered as satisfactory. At all the "chief military stations throughout the kingdom, the principal medical officers have "made reports monthly on the subject, and on all occasions have expressed them-"selves fully satisfied with the *physique* and general appearance of the men who "have joined the several corps." He concludes his report as follows:—"Not only "is the recruiting for the British Army perfectly voluntary, but the standard at "which this number has been raised, viz., five feet five inches for infantry, is con-"siderably higher than that of any other Army in Europe, and that by a slight "reduction of it a considerably increased number of recruits might easily be raised." In January, 1875, General Taylor made another report, in which he again speaks favourably of the recruits, and says that nearly 21,000 men enlisted in 1874, of whom upwards of 12,000 were for short service. Therefore, both as to quality and numbers the new system appears to give promise of success, though of course it requires time to be matured and developed. There are some, however, who will say that the reports I have quoted are merely official, and, indeed, an honorable gentleman, a member of the House of Commons, Mr. Holms, has recently published a grotesque caricature of the British Army, in which he ~~asserts that~~ the Army administrators are blind, feeble, ~~and wrapped up in red tape, and that these reports,~~ are published to mislead the country. Sir, I value them because they are official, and because they are written by men of high rank, honour, and long experience in war, men placed in most responsible positions. I rely implicitly on their statements, and am glad to find they speak so hopefully of the future of the Army, and I confidently quote their facts against the theories of ignorant and irresponsible panic-mongers. Time prevents my saying much more. Localization and the partial introduction of short service afford the best prospects of our maintaining an efficient Army in the future with an adequate reserve. We must, however, improve the militia and blend them with the line. I often hear disparaging remarks made respecting the British Army. It seems a fashion now to decry our forces, and to belaud the armies of foreign powers—but as an old soldier I retain my confidence in our troops, which have never yet failed us. Our men are far better paid, clothed, fed, and cared for than of old; our non-commissioned Officers in point of intelligence and education are superior to those of my young days. Whilst our Officers retain the high spirit which has always distinguished them; they are far better taught, professionally, than formerly, and are full of zeal. The Army, it must be remembered, serves and fights all over the world. It has a far wider experience than any other nation, and it truly represents the genius and enterprise of the British race. It has always fought well of old, and is ready to fight again. We have, in round numbers, 100,000 soldiers and 366 guns manned and horsed in the United Kingdom at the present moment, exclusive of militia and volunteers, a number far larger than we have usually maintained in time of peace; and, in my opinion, the country is better prepared for war now than at any previous period within my recollection.

Colonel Lumley Graham: I hope you will not think it indecorous in me if I begin what I have to say by something approaching a joke. One of the speakers said something which put the idea into my head. We seem here to be like a set of doctors called in round the bed of a very sick man, that sick man being the British Army; and, as it is proverbial that all doctors disagree, we naturally do disagree on every point except one, viz., that the sick man is very sick indeed. Not only that, but that it will require a very great and long course of medicine and a very expensive outlay to save his life even, and to set him on his legs at all in an efficient state. There was one exception to that opinion which I was very glad to hear, because it came from an Officer of great authority and high standing, and I hope the more cheerful view of the patient's state may be the correct one; but I must say, as far as my opinion goes, I join with the majority in thinking that the sick man is very sick indeed.

We are here to discuss the very able essay of Captain Hime. He took great pains to show that the sick man not only was sick now, but had been sick from the very commencement, from his youth upwards; in fact, there was not a single time in which he was not a very poor, ricketty creature, and that he was always in difficulties. The wonder is that such a ricketty creature has been able to do such good hard service in all parts of the world. I think he must have an uncommonly good constitution to go through all he has gone through, being such a poor creature. But, however, this is too serious a subject to joke upon. I myself am one of those who think the present state of things is a very unsatisfactory one; that it is useless to attempt to combine short service with the voluntary system, principally for this reason, that you cannot get recruits enough under the short service system, and moreover that we have much too young an Army, that is to say, we have much too large a proportion of young soldiers in the Army, and if we were put against one of the great Continental Powers, we should be at a great disadvantage. With the voluntary system of course we all know we must take men when we can get them; we take lads, in fact boys. Those boys, if they had time, would train up into very able-bodied soldiers, and into better men than if they had remained civilians; but if we have a war they will not have time, and we shall have to take the field with much too large a proportion of young men. Therefore I perfectly agree with Captain Hime, that short service and voluntary service cannot be combined. I do not agree with him in thinking the voluntary service must be superseded by conscription. I think there is no doubt the whole question is one of money; you must pay in one way or the other. I think we are all pretty well agreed as to that—you must either pay directly, by raising the advantages or pay of the soldier, or you must pay indirectly (and I believe it would be a far greater amount in the long run), by having universal conscription. I do not for a moment believe the system Captain Hime has recommended would work, that is to say, a home Army of one year men. We may train men to be soldiers in one year, that is, we may make them march past, we may make them go through their drill creditably, and even shoot fairly, but as for making them soldiers in one year, I deny that we can do so, even with infantry, and I ask any artillery or cavalry Officer or engineer Officer if he thinks either cavalrymen, artillery, or engineers can be made in one year. According to Captain Hime's proposals, the home Army is to consist of one year men. Supposing war is declared, we have to take the field, perhaps on the continent, with an Army composed entirely of one year men, supplemented by a reserve of men who have also only served one year with the colours, and have been two or three or four years in civil life afterwards. Would an Army of that sort meet the Army of Prussia? Colonel Leahy supported Captain Hime in thinking one year was sufficient to train a soldier.

Colonel Leahy: I said to teach a soldier his duty; and that one or two subsequent summers with manœuvres would complete his training.

Colonel Lumley Graham: As I understood Colonel Leahy, he thought one year was sufficient to make him a soldier, and he referred to cases of training he gave to men at Chatham; but I think the men he alluded to were either Royal Engineers, a better educated class of men than the line soldiers, and therefore who could be trained in quicker time; or they were men in the line who had been already two or three years in the Army. Then he alluded to the

Prussian Army. It is quite true a large proportion of the Prussian infantry are not two years with the colours; but then the non-commissioned Officers are almost all re-engaged men. Captain Hime's proposal does not appear to allow for re-engagements in any way, therefore we should have, not only one year's soldiers rank and file, but one year non-commissioned Officers, and I do not think that would work. I merely wish to make a suggestion which has occurred to me, as a way of overcoming the difficulty. I still wish to preserve the voluntary system with comparatively long service; at the same time I think it is better to utilize what we have, than to pull down everything and build up something else: therefore, I should like to preserve our present reserve forces, the militia and volunteers, because I believe they are capable of being made very good use of, if organized in the proper way. I should propose that the militia should be the foundation of the whole military system, and that the militia alone should be raised by conscription. By conscription I mean, as Captain Hime says, without dotation and without substitutes—a conscription applying to the whole people with, of course, the exemptions allowed in all countries where conscription is the rule, and with this addition, that really efficient volunteers should be exempt, a high standard of efficiency being fixed, thus making the volunteers take the place with regard to the militia of the English Army, that the one year volunteers in Germany do to the whole force. Now, the number of youths attaining the age of eighteen annually in the United Kingdom, is nearly 300,000, a much larger number than the quota which would be required for the militia. You could, therefore, afford to fix a high standard of efficiency for the militia conscript. As I should look to the militia as the force specially for home defence in case of war, I would have the regiments at all times organised in brigades and divisions. I look also to the militia, as the source from which the greater part of the Army recruits would be drawn; and in order to provide for volunteers to the Army without impairing the efficiency of the militia regiments, I would enrol annually a proportionably larger number of conscripts than would be required to keep them up to the proper strength. I think we could recruit the line very largely from the militia in that way, without impairing its efficiency, and we should get a superior class of recruit, because we should be certain of getting men whose characters we know something about; we would not take men of bad character, or who were physically unfit. Let the line soldiers serve ten years, then I would say, "You have your free discharge," except good non-commissioned Officers, retain them, by all means. I would allow good non-commissioned Officers, and perhaps a few picked men who might be useful—musicians, and so forth—to re-engage for a further term of five or ten years. I would say to the rest, "You may join the Reserve for ten years." The temptation to do so would be, at the end of the twenty years' full service in the Army and Reserve, I would give them a pension. To those re-engaged soldiers who served their whole twenty years with the colours, I would give a still larger pension—let them retire on full pay. I would give the Reserve man, retired after the twenty years' combined service, a reduced pension. What I look to is the prospective advantage held out to the soldier. That is my idea of it, very briefly. And then, again, I would retire some of the old soldiers, men who have passed through this twenty years' service, into the militia, for training purposes. I have not time to explain my plan fully now, but I may follow the example of other speakers and say, I am one of the unfortunate competitors. I should think it would be cowardly not to say so after Sir John Adye has said it; otherwise I should have concealed my defeat. But since I wrote my own essay, I have read an essay by Captain Trench, which I prefer to my own, and it appears to me to be one of the best solutions of the subject I have met yet, and I recommend it to your notice. Captain Trench holds out, in a different form, prospective advantages as a temptation to men to enlist, and I think, perhaps, in a better form than the way I have put it. He proposes that the pay of the soldier should be raised by sixpence a-day, and that this extra pay should be kept in hand and paid him at the end of his service. That is where I think we may find a solution to this great difficulty; it is in comparatively long voluntary service with prospective advantages for the Army, and in conscription for the militia.

Captain LUARD, R.E.: Sir W. Codrington and Gentlemen,—I must crave your

indulgence, for I am in a very exceptional position. I am *not* one of the sixty-eight or seventy-eight disappointed essayists, and shall therefore be at greater liberty perhaps to criticise these essays than those gentlemen who have competed for the gold medal. I am sorry to see Sir Edward Warde has just left the room, as I proposed to make one or two remarks on his paper.

Assuming that voluntary enlistment will have to be the case for some time to come, I should have spoken up very strongly in favour of regimental enlistment. I am quite convinced it would facilitate the accession of recruits very much indeed if men were enlisted especially for regiments instead of for general service; and I feel sure that the contrary system has militated very much indeed against our obtaining recruits. I do not exactly understand why short service should have entirely disturbed or destroyed *esprit de corps*. I was not aware it was the case in the German Army, where they *have* short service; and I am sure it did not display itself in the last great war. Sir Edward Warde has said, that voluntary enlistment is the great glory of this country. I cannot quite see that; it has appeared to me to have become an absolute failure. It never has been maintained (as Captain Hime has most clearly shown) in times of pressure, except by means of bribery in the shape of large bounties; therefore I do not think it is a great glory to us. The formation of reserves is a portion of the subject for which this gold medal was proposed to be given, and it is a very important one. Sir Edward Warde's scheme would appear to me to be an extremely costly one, and I am very sorry be did not show us in some way what it would have cost. He proposed that every man should serve three years in the militia after having served a certain period in the line; that whatever length of service he takes with the colours, whether he re-engages or not, he is still to serve three years subsequently with the militia. I wanted to know what pay Sir Edward Warde proposed to give them, because if they were to get full-pay, no doubt you could always lay your hand on your men when wanted, but when they were called out for actual service they would receive no greater pay than when called out as militia are now, for only a month or so in the year. But on the other hand, if they are only to get the sixpence a-day of pension that has been suggested, I do not think it would make any practical difference from what is now the case: you now give a Reserve man fourpence a-day, and you may whistle for him when you want him. I am rather sceptical about the existence of Reserves at present. Captain Hime's essay is a most admirable historical sketch, but I am afraid it ends there. I cannot see that this essay (and not being a disappointed essayist I may speak with perfect freedom on the subject) is much more than a very crude scheme indeed. As Colonel Lumley Graham has pointed out, there are 100,000 men proposed to be trained for one year, and then they are to be drafted into a Reserve, where they serve four years, because, in the tabular statement at the end of his essay, Captain Hime has shown that men are to be the first year with the colours, the second, third, fourth, and fifth years in Reserve, and then they disappear.

Captain HIME: That has only been suggested.

Captain LUARD: It appears to me that you would have 100,000 recruits and 400,000 men in the Reserve, but you would have no fighting army whatever. Where is your Army? Do you suppose if you took 100,000 recruits into the field they would last any great length of time? Do you suppose, Gentlemen, that any of you would be successful if you kept a large stud of racehorses, and put them into the ploughs and carts, and so on, until they were about four years old, and then put them into training at a considerable expense; trained them say for a few months, and then instead of running them, sent them out to grass again; and then, all of a sudden, when they are five or six years old, start them to run against well-trained horses!—what result would you expect? A man would be considered a fool to do such a thing! If we know then how to manage our racehorses properly, surely we ought to be able to understand the powers of men. The suggestions of Captain Hime are condensed into a page and a half at the end of his essay. I believe the essayists were asked to say *how* they would provide recruits and reserves, and that is the pith of the matter, which has apparently been omitted.

But I cannot help thinking the question has never been presented to the country in a proper light. I do not myself believe that it is the function of the *Army* to produce its own recruits. I believe that this is a *civil* duty. This nation I believe

is at present in a most peculiar and most critical state. It has arrived at an unbounded pitch of wealth, utterly unexampled in the history of the world, and I believe that is a most dangerous condition. If you look into the history of ancient nations, of Assyria, Persia, Rome, and, last of all, Spain, you will see that wealth has been the main cause of their ruin. We have hatched this gigantic egg, wealth, and what has it produced to us? It has produced *moral blindness*. The result of this moral blindness shows itself in various ways. We fail to recognise that we should insure our national property properly and to a fair extent; we also by reason of our moral blindness have become utterly oblivious to what is called patriotism: we do not now fully recognise what patriotism means. I am quite sure it never will be sufficient in the future for this country to vote money only. Some call money the "sinews" of war; but what, I ask you, are sinews without flesh and blood? They must not only vote money, but they must find men—men such as will be fit to cope with the armies of foreign nations. The only way to do that is by conscription, or a general liability to military service. We are not here to air our own dogmas; we are called here and invited to criticise and to discuss these able papers prepared by Sir Edward Warde and Captain Hime, and therefore I do not propose to air any dogmas of my own, or to show you how that conscription should be carried into effect.

The CHAIRMAN: As there are many Officers and gentlemen still wishing to speak, we must again adjourn our discussion till to-morrow; but as Captain Hime will not then be able to be present, I think it only right that we should give him an opportunity of replying to the observations made upon his essay.

Captain HIME: I rise under circumstances of very great difficulty indeed. I think I may describe my position here as that of a kind of military Ishmael; I find everybody is very angry with me, everybody has shot a dart at me, every morning-paper has struck against me, for writing what I believe to be the truth. Happily, however, most of those arrows have gone over my head; they have not been directed against me, but at some terrific chimera, some hideous shadow which stands either beyond me, or on one side or the other. With very few exceptions, indeed, every critic whom I have heard speak here, assumed at once, and most wrongly, that I propose to introduce conscription into the English Army at once. As I have already explained, I do not propose conscription; I say what I firmly believe, that conscription is inevitable, though it may not come to-day or to-morrow, or in ten, or even twenty years. I hear the torrent behind me, though I do not know how far it is off, and as I believe it is surely coming, I hold it to be common prudence to embank the house.

Lieutenant Champion said, my idea of conscription was a prophecy. If so I am Saul among the prophets, for there is not a single speaker in this room who has not prophesied freely and frequently.

Colonel Cox, of the Royal Engineers, at once assumes that I propose conscription. I do not propose conscription, nor do I assume it will come on us at once. I say it is inevitable; I propose it should be universal when it comes; and I have gone so far as to venture to point out the steps we should take with the Army until conscription arrives. As for these steps, I see no better means of carrying on the Army until conscription arrives, than by combining the schemes of Sir Edward Warde and of Sir Lintorn Simmons. Sir Lintorn Simmons wishes us to get better men, older men and stronger men, and Sir Edward Warde wishes us to introduce long service with pension. These are questions, however, I cannot enter upon. It is for this meeting to settle the system under which we should carry on the Army until conscription which is inevitable, becomes necessary. Colonel Cox proposed a number of schemes; but they all amounted simply to an increase of the estimates; in other words, to precipitate the period at which conscription must arrive.

Colonel Leahy quotes Mr. Holms to prove that Parliament would not at present hear of conscription. I feel certain that Parliament would not, because Parliament must follow the country, and I believe the country would not hear of conscription at present. Almost all the morning newspapers have criticised my essay, and one and all combine to say the country will not at present accept conscription. In that I fully agree.

Mr. Walton says the problem of the reconcilement of the two antagonistic ele-

ments of men and money has not been solved in my essay. My answer is, that it was impossible in an essay limited to thirty-two pages, to enter into many of the points connected with the gigantic question of recruiting. I could not do so with any chance of success. Mr. Walton further says that with my system of conscription, we should only have half a million of men in four years, while foreign nations have two millions. The object of my conscript army is not that of offence; it would be a purely defensive army. Every one knows that owing to our insular position, our first line of defence is our glorious Navy. We have scarcely ever been able to carry on a continental war with a large army. Our Army must be chiefly a defensive one, and it was merely with a view to form a good defensive army that I made the propositions contained in my essay.

Sir John Adye alluded to the conscriptions in France and Germany, and then concluded that England would not accept conscription. The logical conclusion to be drawn from General Adye's remarks on conscription is, not that it is unsuitable to this country, but that it would be unsuitable if carried out on the continental models. Let the Prussians and the French object to their conscription. The conscription I propose is neither Prussian nor French; it is purely English, and it is a matter of opinion whether it would work well or ill.

Colonel Lumley Graham referred to our past victories, and said it was very odd, if this poor invalid had always been ailing and was so bad as I have made him out, he should have gained the glorious victories he has done. If our victories are pointed at on the one hand, I point to our national debt on the other hand. That will explain the enormous sacrifice we have had to make in money, to enable this cripple to keep upon his legs. He again pointed out that in case of war the men I should send out under my system would be recruits. Granting, to some extent, and I cannot grant beyond a certain extent, that this is the fact, my reinforcements would, at all events be as good as those we sent to the Crimea. Sir John Burgoyne described those re-inforcements as "a vast number of recruits," and gave it as his opinion that if the reinforcements were to be of this character he would prefer to have a handful of real men rather than this mass of immature boys.

And now, Gentlemen, having briefly mentioned the few arrows which I consider have pierced me to a certain depth, I must conclude. I consider that owing to the fact that nearly every one has taken for granted that I propose conscription at once, my system remains almost untouched. It may have been pointed out that a brick is rotten here and there; that the fire-place in one room smokes; and that in another some paltry matter of detail needs alteration; but the edifice stands there still, and I do not think anybody has very seriously damaged the foundations. My facts have never been called in question; my arguments are undisputed; and my position, therefore, is this: I have proved that the three angles of a triangle are equal to two right angles, and you cry out—"The people of England will "not hear of it. They do not wish to believe that the three angles of a triangle are "equal to two right angles, and it is very wrong of you to insist upon proving it." Under these circumstances I shall conclude my remarks, as I conclude my essay:— "Conscription may be unwelcome to the Officers of the Army, it may be irksome to "the poor, and it may be hateful to the rich; but conscription is inevitable, "because it is a logical and necessary consequence of the industrial progress of "modern Europe."

The CHAIRMAN: It is fair to say with regard to Captain Hime's remarks about conscription, that the heading of his essay has naturally given rise to the idea that he certainly was in favour of conscription, because it is headed in this way, "Universal Conscription, the only answer to the Recruiting Question." I think you must be aware that that was the reason everyone has thought you were in favour of conscription?

Captain HIME: So I am, in one sense of the word.

Lord ELCHO: I am sorry that Captain Hime will not be present to-morrow, as I shall have to make special allusion to one paragraph in his essay, and I would rather do so in his presence than in his absence.

Adjourned to Tuesday, April 13th.

Tuesday, April 13, 1875.

(General Sir William J. Codrington, G.C.B., in the Chair.)

Adjourned Discussion on Recruiting.

Captain Owen, R.A.: I must commence by apologising for any shortcomings you may find in my remarks, for I was not one of the competitors for that medal which Captain Hime carried off so successfully by his able essay: still I have long studied the subject, and it does not seem to me that the solution offered to us in Captain Hime's essay is a successful one. Captain Hime is of opinion that universal conscription looms in the distant future as the inevitable fate of this nation. He hears in the distance the awful tread of this monster—more fell than the chimera of old. Sir Edward Warde, who delivered a lecture on the same topic in this Institution, offered us, on the other hand, quite a different scheme; but that, too, seems to be an incomplete scheme, rather a patchwork scheme, in which a good many details of minor importance are discussed. Universal conscription, I believe, Great Britain is not at present prepared, nor will she ever be prepared to take as a burden upon her shoulders. Now is the time to prepare herself in order to prevent that necessity. While the sky is clear and the day is bright, let her prepare herself for the storm which must inevitably come, by establishing an Army with sufficient Reserves to guard these islands and preserve her empire. Such reserves, I think, she can establish under our present system by carrying out the law as now existing in this land, that is, by enforcing the ballot for the militia. Of the militiaman we unfortunately hear but little, save a hackneyed line from Dryden, and a very sorry joke now and then as to his ability. Colonel Lumley Graham appears to me to have struck the right key, when talking of this constitutional force. We have had it repeated *ad nauseum* that, as at present constituted and officered, and so on, this militia is not a force which we could put in line. This may be so, but is it not capable of improvement? I think it is. So also are our volunteers. At present, I must confess, they appear to be worse than useless. By their numbers they impose upon the nation, while they have little more cohesion than a rope of sand, and are utterly destitute of military discipline. Captain Hime has put much valuable statistical information before us, and from it has endeavoured to prove that voluntary enlistment for our Army is and always has been a failure. But how does he prove it? Merely by the cost. He points to our National Debt as proof positive that this system has failed. On the other hand, can we not point to the wonderful progress of this nation, its wonderful development; would that progress or development have taken place had we laboured under the iron grip of conscription? I think not. As to comparing the cost of the regular army under this system with the cost of the continental armies under conscription, it seems to me quite impossible. Who can reckon up the awful loss to the nation of taking away her workers and converting them into soldiers—taking her working bees, instead of taking, as we have done, the drones who would never work, and making them into useful soldiers. Before discussing how we should obtain our forces, we should know, in the first place, what are the forces we require? It appears to be generally agreed upon, that we require a sufficient force, in comparison with those of the Continental Powers, to be of some importance in an European crisis; that is, a force certainly of not less than 60,000 or 100,000 men, well equipped and ready for war at a moment's notice, backed by 200,000 trained soldiers as reserves, in order to uphold our dignity, and to preserve this island in its integrity against invasion. For obtaining this Army and these Reserves, we have had laid before us, here and

elsewhere, three schemes: one, that of Captain Hime's, in which conscription appears to be the inevitable end; another, that in which, with an army recruited by short service, we have reserves filled in from that army entirely; and the third, in which we have a regular army of long service, a Colonial and Indian Service, and reserves of short service, quite distinct from this Army, but affiliated to it, and supplied by it with trained Officers and non-commissioned Officers, and a certain proportion of men to form as it were a backbone. With regard to these three sources, no doubt the first is clear, logical, and simple; but I am certain that this nation is not prepared to bear such a terrible burden; nor is there, to my mind, any necessity for her doing so. The second course, that we have a standing Army recruited by short service, and reserves formed therefrom, has also its advantages, and to the professional soldier many more advantages than the third one. The third is the one, however, which I wish to advocate, because it seems to me the only one which we can carry out to the satisfaction of the nation. I am not alone in this opinion. Colonel Lumley Graham has already expressed his views upon the subject; and there is an able pamphlet, written by an Officer whose absence we must all regret, in which similar views are advocated. I allude to "Army Reforms and Militia Reserves," by Colonel Anson. A former speaker implored us to raise the discussion out of the sphere of argument upon petty details, if we wished to lead public opinion out of doors, without which being gained, the object we have been talking about cannot be carried out, that is to say, the formation of proper reserves. I will try to act on this advice, Sir, and lay before you my proposals in a few words. Let any standing Army be recruited voluntarily, short and long service running *pari passu;* let discipline be stringent; let deserters be dealt with with an unsparing hand. Above all, let us have pensions; come what may, we must have pensions if we want to have a satisfactory standing Army. It is the enfeebled, mutilated soldier, sickened by foreign service or mutilated by accident or war, wandering destitute through his native village, that prevents our getting recruits; let each veteran have a proper pension, and then in some cozy chimney corner or the tap-room of the village inn, he will fight his battles o'er again, and attract to us many a promising recruit. It is, too, of much importance that the pay of our non-commissioned Officers should be raised, otherwise I fear they will deteriorate still more. Then comes the question, how are we to form our Reserves? By balloting for the militia. Let us utilize those depôt centres, by establishing which, Lord Cardwell, first of War Ministers, attempted an extensive organization, and affiliate more closely to our regulars the reserves of militia, constituted as follows: Call out by ballot annually 50,000 militiamen; let there be no substitutes; let them be called out by local committees in the various districts, each district corresponding to a depôt centre, where the battalion for the line of that district would furnish Officers and non-commissioned Officers for the militia reserves. Let them be called out between the ages of 18 or 19, or 20 or 21; let them serve with the colours continuously for two years, and then in the Reserves for three years. While with the colours, they are only liable for home service, save in case of war, this service to be as far as possible local, but their military discipline would be as strict as possible, and all advantages that could be given, should be accorded to young men passing through universities and colleges, on the one year, Prussian, or some like system. This would supply us with a reserve of really trained soldiers, rather more than the 200,000 men we require, contingencies excepted. On mobilization, the militia under training in the militia reserves, would constitute extra battalions for the regiments of that depôt centre. The battalions under training would be officered by the Officers of the regiment at the depôts, and the reserve militia battalions would be officered by half-pay and retired Officers of the Line, and by county Officers, as at present, who had passed through proper training, of course. Such are the broad outlines of the scheme which I would propose. But whatever scheme we adopt, we must not blind ourselves to the fact that two things are absolutely necessary: one is organization—a thorough and complete organization; and the second is expenditure of money. Whatever scheme we adopt, we cannot escape that. If this country is prepared to keep a sufficient Army and reliable Reserves, upon whatever footing that Army may be recruited or the Reserves formed, she must spend more money than she does at present. Of course, we all hope for

those halcyon days when arbitration may put an end to brutal war, but at present it is but too plain that the old rule holds good:—

> "That good old rule, that simple plan,
> That he may take who has the power;
> That he may keep who can."

Colonel the Hon. PERCY R. BASIL FIELDING, C.B., Coldstream Guards: Sir William, Ladies and Gentlemen,—I trust the fact of my having for some years commanded a regiment of Guards, may be deemed sufficient excuse for my venturing to offer a few remarks in this discussion, for the sole reason that in the Guards we still enjoy the privilege of managing our own recruiting. I was unfortunate in not being able to attend these discussions last week, but I saw in the "Times" a report of what passed on Friday, and am therefore, to a certain extent, *au fait* as to what was said on that occasion. The following remark which fell from the author of the Prize Essay particularly attracted my attention:—"In the present position of the "labour market, and the high standard of all wages, we can but draw our soldiers "from the poor, that is, from those who, under the inexorable law of natural "selection, fail from some physical, moral, or intellectual defect in industrial "pursuits." So much stress has been laid upon this point, and it appears moreover so just, that I feel it requires some hardihood on the part of any one to venture to controvert or qualify it; but I submit, that although no one can be blind to the fact that wages have risen enormously of late years, the scale of remuneration given to soldiers has been more than raised in proportion. I think that almost the only thing necessary to enable us to attain as many and as good recruits as we ever got, is to make that fact known amongst those classes from which we expect those recruits to come. Time will not admit of my going into the question as to how that information had best be promulgated, but I may remark that the circular which I hold in my hand, dated May 1st, 1874, which emanated from the Adjutant-General's Office, entitled "By Authority, the Advantages of the Army," was but a meagre attempt to do so, and, as I am prepared to show, the statements contained in it are calculated to mislead, I do think it had much better have been left alone. I will not take up your time by going into it; but anybody who reads paragraph 12, where it says—a soldier "receives medical attendance gratis," forgetting that he is under stoppages, and which says that he "can save at least £50 out of his pay in "six years," would allow that I do not speak without some foundation. I have said that *almost* the only thing necessary is to promulgate the fact that the condition of the soldier will compare to advantage with that of his brother civilian. Another thing most necessary is that something should be done to eradicate from the minds of the public at large the notion, or rather the feeling, that the fact of a man enlisting, is synonymous with his going to the dogs. The other day, Colonel Green Wilkinson assured me it is no uncommon case for recruits to enlist in the Shrewsbury district, on the condition that they should be brought to his office in such a manner that the fact of their enlistment should remain a secret from their friends, showing that although the motives which induced them to enlist were strong enough to induce them to take that step, still they felt that they had done a thing which they could not be proud of. On the other hand, I have reason to feel assured that it is by no means the fact, as is stated in that paragraph which I read just now, that men only enlist who are driven to it from want of employment. I myself personally question every recruit who presents himself for my regiment, and I can assure you it is the exception rather than the rule, that men come to enlist because they are out of employment and do not know what else to do. I say, therefore, it is most essential that everything possible should be done to raise the Service in the estimation of the community at large. Perhaps one of the best modes of doing this would be to increase the facilities which commanding Officers now possess of getting rid of their black sheep. Means should also be adopted to put a stop at once to the facility which deserters now enjoy of re-enlisting as often as it pleases them to do so. This might unquestionably be done by reverting to the old system of tattooing with the letter "D," and the mere fact of this most necessary check having acquired the name of "branding," given to it by persons of education, who ought to know that to "brand" implies to "burn," shows that

they felt that they could not possibly succeed in getting it abolished, unless they had had recourse to falsehood so as to exaggerate the horrors of the process. I now beg leave to say a few words to establish what I have laid down, namely, that the condition of the soldier will bear comparison favourably with that of his civilian brother. I will preface my remarks by saying that we do not hear of the same difficulties existing in the Royal Marines, as to finding recruits, that we hear of with regard to the regular Army. My recruiting sergeants have assured me it is no uncommon thing for them to see a recruiter of the Royal Marines pick up, without difficulty, a man whom all their eloquence has failed to entice. And why? Simply because the Royal Marine comes home from his five years' cruise with his pockets full of money. It is no unusual thing for a Royal Marine to come home to his village with £25 or £30 in his pocket, and if a similar result could be brought about with the regular Army, I presume the same readiness to enlist would be shown for the regular Army, as is now shown for the Royal Marines. In the Horse Guards' circular before alluded to, paragraph 14, it says, "It has been calculated that a "prudent soldier can deposit 3*s.* a-week at least in the savings bank, and con- "sequently become master of a capital of £50 on terminating his six years' service, "and being transferred to the Reserve." With regard to the means which would enable a soldier to bring home a certain amount of money at the end of his six years' service, it at once occurs to us that the simplest mode would be to keep back a portion of his pay, to be handed to him after his discharge, in the district in which he enlisted, or in any other district in which he may elect to go, by the inspecting field Officer of that district. It is ridiculous to expect that a man should save 5*d.* a-day, but I do think the soldier's pay is sufficiently ample to enable him to do with 2*d.* a-day less, and if he has to put up with a little inconvenience, it is for his good hereafter. I propose, therefore, that 2*d.* a-day should be retained from his pay, to be termed the "reserved pay," and if soldiers who desert be made to forfeit their "reserved pay," the money so forfeited would be added to that of the good soldiers, and so, without any expense to the nation, increase the bonus of the latter. There are doubtless other means by which this reserved pay might be increased. I would suggest that discharges should take place only twice a-year, on the 1st April and the 1st October; that is, that a man enlisting on the 2nd April of this year, should be entitled to his discharge on the 1st October, 1881, and that a man enlisting on the 2nd September, should be entitled to his on the same day. By such an arrangement, not only would a great saving be effected in stationery, correspondence, and all the trouble incident upon the daily discharge of men, to say nothing of the facilities which would be given for sending men home in organised bodies from India after their service there, but it would enable a classification to be made with regard to every six months' enlistment as regards reserved pay. Supposing 12 recruits joined the regiment between the 1st April and the 1st October, 1876, and one of these recruits deserted on the 1st September, 1877, and another in June, 1879, the following sums would accrue to the reserved pay to be divided amongst the other ten who enlisted in the same six months, on their discharge in October, 1882. A. enlisted say on the 1st May, 1876, and deserted on the 1st September, 1877; that would give 460 days at 2*d.*, or £3 16*s.* 8*d.* B. enlisted August the 12th, 1876, and deserted June 30th, 1878; 1,417 days at 2*d.*, £11 16*s.* 2*d.*, the total being £15 12*s.* 4*d.* to be divided amongst the remaining ten recruits of that six months' enlistment, each of whom would get one-tenth of that sum added to their discharge bonus. If any of that lot should have purchased their discharge or died, then the reserved bonus of the remainder would be still more largely increased. I would propose that men invalided should also forfeit their reserve pay, provided their incapacity to serve was occasioned by intemperance or certain diseases which may be specified; the only exception to forfeiture under this clause being such men as shall have completed their first term of service and have become non-commissioned Officers, and so allowed to serve longer. That is my idea of how pensions could be brought about without any expense to the nation, and I think that mode would also act as a very useful check on the practice of desertion and fraudulent re-enlistment. I have accepted six years as the term of a man's service, but I am by no means in favour of so short a service. I think the time of service depends entirely on the requirements of the Service, and if those

requirements will admit of it, I am of opinion that twelve years would be a much better term of service, for the reason that we should always have a fair proportion of well-seasoned soldiers in the ranks. At the same time I cannot but express my opinion, that obligatory militia service for one year for every man capable of bearing arms, is the proper thing for this country. It might be accepted by each individual at any time that he chose to select, between the ages of 19 and 25, and I am quite sure that the acquirement of habits of discipline would do no harm to nine-tenths of the population of this country, and, being only for twelve months, I do not think it would be a very severe burden. Of course there might be exemptions, but that is a minor point which I will not go into. There are three things about which I have no doubt. One is that constant alterations in the limits and terms of service cannot be otherwise than detrimental. Another thing I am sure of is, that men are quite as ready to come forward to enlist for twenty-one years, or for life, as for two years, or any intermediate term. During a considerable period, men were allowed the option of choosing between the two, and the number who elected for short service was ridiculously small. The third thing is, that military ardour, or spirit of adventure, or whatever else you choose to call it, is quite as strong in this country now as it ever was, and that the notions of a military life are by no means unpopular in England.

Referring to what Sir Harry Verney said yesterday, I do think greater stress ought to be laid upon the point that the Army should be the only stepping stone to certain small appointments in the Excise, Post-office, and Telegraph services, and that those appointments should be given to no civilian as long as there is a soldier fit and competent to take the place. I should not regret for one moment to see a dozen of the smartest non-commissioned Officers in my regiment go into such civil employment to-morrow, for I feel sure the Service would benefit by it in the long run, and I feel as sure as that I stand here, there are as good fish in the sea as ever came out of it.

Lord Elcho, M.P.: I came here, not to speak, but to listen, and if it were not for a passage in that pink book on the table, to which I shall presently refer, I should not have ventured to present myself to this very distinguished assembly. But there is a passage in that pamphlet to which I wish to refer, and I can only express my regret that Captain Hime is not present. I am generally in the habit of saying publicly what I think privately, and I would never say behind a man's back what I would not be prepared to say before his face; therefore yesterday, before the meeting broke up, I expressed my regret that Captain Hime would not be here to-day. Before I touch upon this point, just a word about what I feel as to these general discussions. I said I came here to listen and not to speak, because I have this day week, in the House of Commons, a motion which I am inclined to think would recommend itself in its wording very much to gentlemen present. It is to the following effect: "That the state and prospects of our present Army organiza-"tion, as regards the obtaining of a sufficient and continuous supply of efficient "soldiers, are calculated to cause well-grounded apprehension, and demand some "immediate remedy, pending the remote and uncertain results of a more complete "development of the brigade depôt system." That is the motion which I, next week, shall present to the House of Commons, and I came here to gather honey, as it were, from the lips of those who may speak on this occasion, and obtain valuable arguments with which to enforce this motion. I believe that, by the rules of this Institution, resolutions cannot be proposed here, and the consequence of this is that the talk wants focussing, that you cannot get clearly at the expression of opinion on the part of the gentlemen here assembled. I do not find fault with your rules, but coming from a place where we proceed by resolution, this is what has struck me. But even without the aid of resolutions, I have seen pretty strong signs of the opinion of the gentlemen here assembled, upon one point at any rate. We had the pleasure of hearing Sir John Adye address us yesterday. I listened, as everybody else did, with the utmost attention to the opinions which, coming from so distinguished an Officer and Official, necessarily have very great weight. He was sometimes cheered and sometimes his opinions were received with silence, but he sat down under an absolute storm of objection to his last concluding sentence—I might call it, of indignant objection to the proposition that the British Army

never had been is so satisfactory a state as it was at the present time. I observe my gallant friend, like myself, has come to that time of life when he finds glasses of use. He spoke with spectacles on, and I have further to observe this of the spectacles that are used by Officers in the War Office, that the glass of which those spectacles are composed is of a most pinky description, and I suppose it is owing to this that they invariably look at everything, especially at Army Reform, with which they themselves have something to do, in the most roseate of lights; and I only account in this way for the question having been viewed by my gallant friend in a light so totally opposed to the views of the great mass of the gentlemen here assembled. I further gather, that the principle of Army conscription is not accepted by those present, that is to say, you do not believe that the time has come for conscription for the Army, and I was afraid no one would get up and say a word for the establishment, or rather for the putting in force of the ancient English constitutional law, as it now stands on the statute book, viz., that for our home Army—the militia—the existing law is that of universal personal service. And when you talk about the Prussian service, I say the Prussian can be shown, in a great measure, to have been taken from our own, for this old English law of personal service existed long before Scharnhorst reformed the Prussian Army, and our volunteer is the equivalent of the Einjähriger in Prussia, who is exempt from more than one year's personal service, on condition of his bearing his own expenditure and submitting to the required drill. On similar conditions the English volunteer can escape from liability to personal service in the militia. I was specially glad, therefore, when Colonel Lumley Graham brought that forward, because I have been preaching and writing nothing else for the last ten years, in the House of Commons and everywhere else, in almost identically the same terms. I was very glad that that was received with a cheer, not quite as strong as that contrary cheer which greeted my gallant friend behind me, but it was at least as strongly approved of apparently as was any other question which has been brought before this meeting. Therefore, there evidently is in this room a feeling that it is not necessary to knock away everything that we have got, but that we may make use of the existing law and apply it, and may find in that a remedy for the existing state of things. I shall not further touch upon this point, but I will say this, that it appears to me, though with all deference as to what should be done, there are certain things which are simply matters of common sense, as to what is and what ought not to be, and I shall be very much disappointed if it is not the opinion of this meeting that, as regards the manning of the Army, the present state of things is extremely unsatisfactory; that, in the present state of European armaments and feeling, we ought not to sit still and do nothing, trusting for a remedy to the complete development of the brigade system in 1879. I do not ask you to give any opinion upon the next point, as it might lead to controversy, but my own individual opinion is that, at the best, the brigade depôt system is a doubtful and insufficient remedy. I am further inclined to think, if we were at the present moment obliged to raise the existing cadres of our infantry, which are kept between 400 and 500, and which the Secretary of State for War told us would require 58,000 to put them on a war footing, that these battalions would naturally, from their heterogeneous composition, be less reliable and efficient than the more homogeneous regiments which fought at Alma and Inkermann, and in the Indian Mutiny. That does not admit of dispute. The idea of putting into a regiment an additional two-thirds of men who have never seen their Officers, is utterly absurd. I hold that no recruit can be reckoned an effective soldier, fit for service in the field, under twenty years of age at least; that, properly speaking, thirty-five or thirty-six should be the limit of age for soldiers for active foreign service; that the reserve men should be called out, and their existence and fitness tested at the autumn manœuvres and drills; that in the militia,—and this I know was General Peel's idea,—for every man who enters the militia reserve, the Colonel of the militia regiment should be allowed to raise another to take his place; that the militia reserve, therefore, should be borne in excess of the ordinary militia establishment, and that they should be annually trained, not with their militia regiments, because what you want is to work up these men who are to be in the Army with their fellow soldiers with whom they will have to serve, but they should

be only trained with the depôts of their affiliated line regiments. I have of late been in communication with Officers, in the House of Commons, and with Members of the House of Commons, and that is about the substance of what we are all agreed upon, and I see, by the cheers with which you have received every one of these statements, that I may go to the House of Commons and say they are practically endorsed by the opinions of the able and practical soldiers I have now the honour of addressing.

I now come to what called me really to my legs, and that is a passage which I shall now read to this meeting which appears in that pamphlet, and I do this really in the interests of this Institution of which I am proud to be a member, quite as much as for any other reason whatever. The passage to which I refer is this. Captain Hime says, "But we have 180,000 citizen soldiers, it may be urged. I "know something of the volunteers, and my conviction is that the only end gained "by supporting them is the gratification of our national vanity. Not long ago an "Austrian officer irreverently described them as a harmless joke! They may be a "joke, but they are certainly not a harmless one, for they are filling the country "with an Army of mock colonels and majors who, if an invasion did take place, "would cause incalculable harm by the tenacity with which they would cling to "their relative rank." I venture to think that there is a twang of what I may call "trades-unionism" about this passage, which goes far to diminish the effect of what I may call the somewhat dogmatic dicta which are found in that pamphlet. I do not stand up here to defend the volunteers. I do not stand up here to say whether they are, or are not capable of being made disciplined and efficient soldiers. Men as experienced in war as the gallant Captain—Lord Clyde, for instance—have held a different opinion. I leave those two to balance each other upon that point. But what I want to point out to this meeting is this, that in this country we live under a constitution of Kings, Lords and Commons. We live as regards matters of defence and military organization, under a constitution of army, navy, militia, yeomanry and volunteers. That is the law of the land; I do not say whether it is right or wrong. I believe it may be made right by a little screw, and it does not require revolutionary and violent changes, but as long as that is the law of the land, and as long as we have this United Service Institution, consisting as it does of the army, the navy, the militia, the yeomanry, and volunteers, I say it is not well for one officer of one branch of the service to write in the way Captain Hime has done of his brother officers. I use the term "brother officers" advisedly—and why? These gentlemen who hold volunteer commissions have come forward at their country's call; they have done it without pay; they have submitted to great discomfort, great personal inconvenience and pecuniary sacrifices, and they do so because it is the law of the land, and they are told by the responsible military authorities that their services are required for the State. I say, then, that it is not becoming on these grounds to speak thus of these gentlemen; but there are other grounds. It is not becoming for one officer to speak in this tone of others whose qualifications and whose commissions stand on precisely the same footing as his own. What do I mean by this? I mean that the qualification of an artillery officer is fixed by competent military authority; I mean that the qualifiation of a volunteer officer is equally fixed by the same supposed to be competent military authority; and I say further, the commission of the artilleryman and of the volunteer are both signed by the same sign manual of the Sovereign. I therefore venture to speak in the interests of this Institution, and to point out that there is no branch of any profession, that there are no men who do not, more or less live in glass houses; and that although they say glass is now made so unbrittle that you may in safety throw stones without being able to break windows, still I venture to think the old proverb holds good, and that we had best not throw stones at each other, besides the reasons that it is not wise in the interests of this Institution to do so. For where would such a system end if the officers of one branch of the United Service were to follow Captain Hime's precedent and to write and speak of each other in the tone which this gallant officer has adopted? I can only regret that this statement should have appeared in print. I do not know who is responsible for what is printed by this Institution, but I think in its own interests it would have been wise if a little expurgation had taken place, and if it had been suggested to Captain

Hime that it would have been better not to have placed before the world the passage to which I have ventured to draw the attention of this meeting, and I heartily apologize to you for having ventured to do so.

The CHAIRMAN: Before I call upon any other gentleman to speak, perhaps you will allow me, as having been one of the referees, to refer to this very question. I am sure that no one in this assembly, certainly not one of the three referees, would object to the way in which Lord Elcho has brought the subject before this meeting. He is perfectly entitled to bring forward not only the general question as to whether it is prudent in an Institution of this sort to use any expressions offensive to others, but he also is particularly entitled to defend his own particular corps, namely, the volunteers. The utmost liberty was given to the essayists with regard to the character and scope of their essays, and we, as referees, did not look solely to one point or to another point; it was the general system laid down, the language and various other matters to which we referred in a letter to the Council (not worth repeating to you now), that caused the decision for the gold medal. We do not hold ourselves actually answerable for the good taste, propriety, or correctness of expressions used in those various essays. I do not mean to say there is not a single iota of responsibility put upon the referees, and incidentally, although only incidentally, upon the Council for what is published in their name; but I think on the other hand, that the liberty of expression is so far valuable that it is better not to excise or to interfere with an essay if possible. I will also say, and possibly it may be allowed to express the feeling of this meeting; at all events I may express my own and that of the referees, that nobody can quite approve of the tone of that passage of Captain Hime's essay referred to by Lord Elcho. As I was mentioning just now, there is no necessity for such strong terms, and I am quite sure if Lord Elcho will be kind enough to take it from the general expression of this meeting, there are no people who so value the volunteers, their extreme patriotism and their services of such excellent sort, if we were attacked, as the officers of the Army. It is my firm impression that that is the case. You will find a great number of people who say "you have not the necessary discipline; you are only casually brought "together; you have not that feeling that a soldier has," and various things of that kind; but I am quite sure of this that the nation feels and the Army with it, that in the 150,000, or 170,000 volunteers we have an excellent and a very waspish set of people, who would be always dangerously buzzing about the ears of an invader. I think Lord Elcho may be satisfied that there is that feeling in the country, and the casual expression of an Officer, although in a Prize Essay, must not be taken as representing the feeling of the Army.

I have been asked by General Adye to allow time to make an explanation in answer, but I must follow the rule that generally obtains in the House of Commons, namely that an explanation must be confined to something that Lord Elcho may have misunderstood, and as it were mis-stated. If General Adye will tell me that is the case, I dare say the meeting will wish to have any explanation, but otherwise we must not have a second speech.

General ADYE: I am only anxious to get up for one moment to reply to one or two observations of Lord Elcho.

The CHAIRMAN: I think, General Adye, it must not be that. If there is any misunderstanding that Lord Elcho has fallen into, or in what you have said that you wish to explain, that is fair enough, but it must not be a question of answering arguments. It is not with a wish of preventing discussion in any way, but I am quite sure the meeting will feel that we must confine this discussion within proper limits.

Mr. de FONBLANQUE, Deputy-Controller: The impression left upon my mind by Captain Hime's able essay was that he considered the voluntary system of recruiting to have been weighed and found wanting, and that the only remedy was, universal conscription. To my surprise on Friday, and again yesterday, he seemed to shift his ground, and stated that we were all labouring under a delusion in supposing that he recommended conscription. The title of his pamphlet is—"Universal Con-"scription, the only answer to the Recruiting Question." The question certainly was—how best to recruit the Army? Captain Hime has only given us one solution, namely, conscription. If, therefore, that is not his answer, I am afraid that he has obtained the gold medal under false pretences, for if conscription is not his answer,

then he has given none whatever. We are, however, here not to discuss what he has said, but what he has written; and I accordingly take his essay for my text. In the first place, then, I must express my entire dissent from his two main propositions, that the voluntary system has broken down, and that universal conscription is the only system that can replace it. He admitted the other day that his proposed remedy was a very desperate one, and compared it to the amputation of a limb in order to save a life; but he seems to me to have overlooked the fact that a humane and skilful surgeon, before he amputates a limb, satisfies himself that he cannot restore it, patch it up, and make it useful somehow; and I am quite certain, although the voluntary system may not at present work as well as it has done in times past, that it will again answer every purpose, and that without any desperate operation whatever, we shall continue able to recruit our ranks as we have done for the last 200 years. I will not go the length of Sir John Adye, who declares that our Army was never more efficient than at present; and who, with all the courage of an English Officer, actually quoted a War Office return in support of this proposition. Now I have long served in the same department in which Sir John Adye has recently become a member. I have passed the best years of my life among official returns, and I know, from personal experience, what they are worth. You will, perhaps, allow me to give you an illustration. While I was in commissariat charge of a division in the Crimea, I received an order in the spring of 1855 to furnish a return of the number of days during which my division had been short of rations. That number was, unfortunately, considerable, but when I came to work up my report from the only materials at my disposal—official documents—not only did I establish that the men had had full rations for every day during the whole of that winter, but that for three weeks of that time they had had double rations, and that so far from having been starved, they had been greatly over-fed. When I showed this return to Lord West (a member of the Board) he said:—"This is very satisfactory, "but pray are these facts or figures?" I said—"They are figures." "Well then," he said, "throw them away." So much for the trustworthiness of official returns, however conscientiously compiled. Now as regards conscription, I am surprised that anyone can, for one moment, seriously entertain the idea that it would be accepted by the British public of any class. Captain Hime speaks of it as being irksome to the poor and distasteful to the rich, but the class it would affect and offend most is the largest and most influential class in the country, namely the middle class, whose feelings and interests would be most outraged by such a law. Again, our insular position, as all admit, makes the Navy our first line of defence; and if conscription were necessary for our Army it should be even more so for the Navy; and yet although many Naval Officers complain that they cannot get the right sort of sailors, I have never yet heard any one recommend conscription for the Navy. There is another point upon which I will touch. There is no public question that we can discuss without considering that which it always resolves itself into sooner or later—viz., *£ s. d.* To that question Captain Hime has completely given the go-bye. He proposes a voluntary Army for the Colonies, and a conscript Army for Home. The Army to serve in the Colonies and India must necessarily be a long service Army and confined to climates more or less unfavourable to English constitutions; consequently these men will require a higher rate of pay than is now given. How is this additional charge to be met? We have 68,000 men serving in India and the Colonies, therefore, we may say that nearly one-half of the Army would be in receipt of a very much higher rate of pay than at present. Are we to meet the expense by reducing the pay of the conscript? Are we to assimilate the pay of the conscript soldier in England to that of the conscript soldier abroad, which is merely nominal? in other words, are we to say to our new conscript Army—"Hitherto we have had "voluntary service at one shilling a day; for the future we will have compulsory "service at sixpence a day." But even then the cost of the proposed Army would be in excess of the present one, and I should like to see the statesman who would get up in the House of Commons, and in one and the same breath propose to impose a law obnoxious to the instincts of every Englisman, and a very large increase to the Army Estimates to meet the expense consequent upon the introduction of this law. I regret that Captain Hime is not present, because I should have liked to put one or two questions to him on the subject of expenditure. I will conclude by saying that

if it be true, as he asserts, that "no sane man" can have a doubt as to the success of his scheme. I must, in common with many others at this meeting, rank myself among the non-sane part of the community.

Colonel AIKMAN, V.C., Commanding Royal East Middlesex Militia: Sir, I presume it is the object of this meeting to discuss Captain Hime's excellent paper rather than to form theories of our own, or to enter into the question of reorganization of the Army.

I shall, therefore, confine my observations to a few points of the essay, as the statistics and figures contained therein do not appear to justify the conclusions arrived at by the author in regard to recruiting.

We must, however, admit that the essay contains a great deal of useful and reliable information, showing clearly the amount of desertion in the various branches of the Service; where that desertion has been most prevalent; and the causes during the past century which have produced it.

The figures show that desertion is more prevalent in short than in long service, though the former is more popular than the latter.

When desertion takes place in the latter it is found at the commencement of the term when the pension is far distant. If the recruit gets over the first few years, desertion decreases; and, as the pension draws near, it entirely ceases. This shows that the less popular service is accepted on account of the pension, and that prospective advantages are highly prized.

It is evident, therefore, that by a compromise between the terms of long and short service, a suitable arrangement might be found to produce a sufficient supply of able-bodied men to meet the requirements of the Army at home and abroad without resorting to conscription.

Captain Hime informs us that while the pay of the soldier has slightly improved his income has enormously increased of late years—that heavy expenditure has been incurred rather in improving the soldier's condition than in increasing his salary. It is true that comfortable barracks, wholesome food, well-arranged hospitals, and good medical attendance have been provided for the soldier, but if we look into the condition of the working classes we find politically, socially, and morally, the improvement in their circumstance has been even greater. Wages have been considerably raised, and hospitals provided at the public cost.

In comparing, therefore, the income of the soldier with that of the civilian, the cost of living should be dismissed from the calculation, and we should ascertain how much each has to spend after the necessaries of life have been provided. I think it would be found that the soldier is the poorer man of the two. If we look into the homes of the poor, possibly we find less space, less cleanliness, and less fresh air to breathe than in the barrack-room; but the civilian has what he prizes most, and what the soldier does not possess—his liberty; and though the dwelling in which he lives may appear wretched, it affords good shelter, and the position, to those accustomed to it, is by no means so bad as we imagine it to be; and, on the whole, compares favourably in their estimation with the monotony and restraint of military life.

We are next told that there is a growing disinclination among the industrial classes to enter the military service; and that as trading operations have extended, the military spirit of the people has declined. We have only to look at 180,000 volunteers, composed of all classes, performing military duty voluntarily, to be convinced that the military spirit of the nation has never been higher than at the present time, and this may be ascribed to the thorough absence of compulsory service.

The essayist suggests that the Reserve soldier will not be forthcoming when wanted, while he infers that the conscript will.

There is nothing to support this conclusion. On the contrary, there is considerable evidence to show that this charge, which has been repeatedly made against a body of deserving men, who are entitled to our confidence from their past services to the State, is without foundation.

Let us take the case of a militiaman to show whether these people are given to breaking their engagement. The man enlists generally in winter, when in distress, for the sake of a few shillings, which are deducted from his bounty at the end of his training. He is usually a man of unsettled habits, with no fixed residence, or

regular occupation. If he choose to desert, there is little chance of apprehending him; yet when summoned for duty, at a time when he may be in remunerative employment, he comes at considerable sacrifice and inconvenience to himself, while his family are often left destitute and dependent on the workhouse. I grant that many disappear, some leave the country; but when we find an average of nine hundred men out of a thousand on parade, and that the militia have done good service in time of war, it can hardly be said, that as a class, they do not meet their engagement. Then there are the militia reserve men, of whom we have some 28,000. They are selected men of good character who accept the responsibility of leaving home and family to be drafted into the line in time of war. And what do they receive as an inducement to enter into this important compact? The magnificent sum of one sovereign annually extra bounty!

I have nearly 400 of these men in my regiment, and, by an increase of the bounty, could double the number, and yet we are told that voluntary service is expensive and not procurable, and that conscription, so distasteful to Englishmen, is the only remedy.

If men on whom we have so slight a hold have been found to do their duty in times of peace and war, surely the Reserve soldier who has something to lose, who attends periodically to receive his pay, whose address, description, and occupation are well known, would be found at his post when wanted.

Having endeavoured to show that military service is not distasteful to the people if suitable terms were offered them, and that the field for voluntary enlistment is by no means exhausted, I will briefly state in a few words what is needful in my humble opinion to draw recruits, and the kind of service which I believe would be found very attractive.

1st. We require a simple and intelligible code of regulations showing exactly what the soldier is to receive, and the career which is open to him.

2nd. That a mixed service in the Militia Reserve and the Army extending over twenty-one years should entitle the soldier to one shilling per day pension.

By some such arrangement as this, the militia would be able to send to the Army men fairly trained, physically fit, and of mature age who would, on entering the line, at once add to the fighting strength of the service.

The recruit wishing to join the Army under this arrangement would enter the militia service, say at 18 years of age, and serve four years. He would then enter the Army for six years. Having thus completed ten years' service, six of which have been passed in the line, he would return to his militia battalion (where the military element is so much needed) for eleven years more, thus completing twenty-one years' service, during which time he has been available for war. He would now be transferred to the pension establishment.

The saving effected in rations during the 15 years in Militia Reserve would more than cover the expense of pension. Now what have we been asked to accept as the result of Captain Hime's investigation:—

1st. That the militia is not a reliable force.

2nd. That the Reserve soldiers would not be forthcoming; and, if they were, would be little better than raw recruits; or, in other words, a military mob, the worst mob of all.

3rd. That 180,000 trained volunteers are a harmless joke. Now, Sir, the expressions indulged in towards this force, and particularly towards the Officers of it who have Her Majesty's Commission and wear the national uniform are very objectionable, indeed insulting. Lord Elcho, however, has met them very ably; but what are we asked to do to repair the alleged sad state of our military institutions? We are simply asked to expunge the British Army, which has hitherto been found in quality equal to any in the world, and to substitute for it 100,000 young civilians of twenty years of age and of one year's service or less, a training but little better than that of the volunteers as far as making a soldier is concerned; and these young men are to form our first line of battle. My humble opinion is that a force so constituted, would be a harmless joke indeed in the presence of a foreign European Army, and not nearly so effective in such a position as Lord Elcho's men behind defences and such other places as would be assigned to them in the field. But returning to the *Prize Essay*. There is not a single word touching upon the best

means of procuring recruits for the Army considering its varied duties in peace and war; and, as many of the essays doubtless contain much useful information on this subject, some of the best might be printed to form a volume of the *United Service Journal*, which would be a useful book of reference for those who are entrusted with the difficult task of recruiting and improving the fighting power of Her Majesty's Forces.

Major-General MARRIOTT: I did not give notice of my intention to speak at an early period of the discussion. It was only yesterday, when one speaker after another seemed to me to take the opportunity to express his opinion on matters of detail, while the essay itself did not receive adequate criticism, that I sent in my name as desiring to speak. Since then, in some respects, the defect has been supplied, and one or two points especially have been met. I desired to say something about the alleged decay of the warlike spirit, but that the last speaker and Colonel Fielding have adequately dealt with. I also desired to have noticed the contempt thrown upon the body of volunteers, but Lord Elcho's speech obtained an expression of opinion from the assembly, which renders further notice of that unnecessary; but I still feel that the essay has not been adequately criticised.

When I heard of a proposal, so opposed to the traditions and to the social and political constitution of this country, as "universal conscription," I took up the essay expecting to find it at least supported by grave and weighty argument, and I confess it was with surprise I found the most important points simply assumed, assertion substituted for argument, and the most critical questions avoided altogether, and that even with all these aids, the argument was only brought to a conclusion at the cost of the most extraordinary inconsistencies. Two of the principal points on which he proceeds are, first, that we require a very much larger body of fighting men than is already proposed. Speaking of the Army of 1873, when there were 103,000 men for the home service, beside the whole body of the auxiliary forces, he says it is a force with which it is impossible for us to defend the country in case of invasion; and again, that it is sheer madness to risk our liberties in times like the present, upon the success of such a force. The assumption of the numerical inadequacy is really essential to his argument, because he admits that there has rarely been a scarcity of recruits for long and life service, and therefore, to get rid of the objection that the voluntary system has been sufficient on those conditions, he is obliged to assume that we require an immensely larger force, and to back up that opinion he has to speak of the whole of our auxiliary forces, and especially the volunteers, in a manner which I should have noticed at some little length, had not the feeling of the meeting been markedly expressed already. But I must say, that to treat 150,000 men of the very class from which his conscripts would be taken, a class so superior that he thinks one year's training would suffice to make complete soldiers of them, men who have learned to manœuvre in battalions and are accomplished in the use of the rifle, and who, for the most part, by their education and intelligence, readily apprehend the significance and value of what they have learned; a body actuated by patriotism or military sympathies, and giving willing not compulsory service—to say that such a body of men, at a time of invasion, when their feeling of devotion and ardour would be kindled to the utmost, would be useless, seems to me the veriest professional pedantry and conceit. He gives three "insuperable reasons," fatal objections, he says, against the voluntary system in any shape, viz., that it cannot give a sufficiently large force, that it is enormously and intolerably costly, and that such men as it supplies are of the worst quality. As respects the second objection of cost, I could hardly believe that I read aright on that subject, when he assumes not only that the cost is to be very much less, but actually that the cost, not even of an Army of the present strength, but of an Army of the strength he would have it, would be about one-third of the cost of the present Army. The last Army Estimates are 13½ millions, and the total expenditure of every kind of pay and allowance, from the Commander-in-Chief to the drummer boys, for every branch of the Army, is 4½ millions; so that if the present British Army would serve without any pay whatever, the total cost would be about three-quarters of what it is at present; and yet he says by conscription we are to have an army much larger, at one-third of the cost. What is one to say to such arguments as these? Why, after the great constitutional

objection to a conscription, the next great objection is its cost. It is the most costly system you can possibly have. Where is the saving to be? He says himself, that the soldier is paid less than the day labourer. Does he mean that the labourer whom you take from his labour, the artisan whom you take from the workshop, the man whom you take from his desk in the counting-house, is to be paid less than the day labourer? Where is the saving to be? The indirect cost, on the contrary, of taking men out of square industrial holes, to put them into round military holes, must be enormous. So much I have desired to say on two of his insuperable objections—the cost and numbers. The third objection is quality. On that point there is more semblance of argument, but even in that argument there is fallacy. He says—and the words were quoted by Colonel Fielding—we have to take them from the men "who fail from some physical, moral, or intellectual defect in industrial pursuits." A great many men fail in industrial pursuits, because of a restless and adventurous character, which makes very good soldiers, but I need not repeat what has been said on that subject. He omitted the most critical question of the matter of exemptions. He proposes universal conscription with exemptions, but omits any scheme of exemption. It would be waste of time to state all the possible conceivable plans of exemption and the objections to them; it will be time enough when Captain Hime supplements his essay by a statement of exemptions, to exhibit the difficulties they would involve. The inconsistency with which he concludes is so great that he is obliged himself to notice it. He says, "It may be said to be a monstrous contradiction, first to prove the voluntary system to be a failure, and then to propose a voluntary Army for England and the Colonies. I reply in the first place, that we have no choice in the matter." The contradiction is really still greater. He did not merely say it was a failure. He said the other was the only possible system; but nevertheless we must adopt another, and it is to be presumed impossible one, because we have no choice. I do not see the value of arguments such as that. He concludes by words which combine all the assertion, assumption, and fallacy that characterise the whole. He says that conscription "is a logical and necessary consequence of the industrial progress of modern Europe." I should have rather thought the logical consequence of industrial progress to be, as he himself says in another part of his essay, that men adopt the profession of arms, on the same prudential grounds that they adopt other professions or callings. The traditions of a nation and its government will not be changed by such mere assertions as these. Military constitutions are not made, but grow like other constitutions, and moreover they have their roots in the political constitution of their country, and they cannot be torn therefrom and replanted in a foreign and imported soil. Guidance for the future we must seek in the past, and I cannot say that I see in the past what the essayist sees—the sure foot of conscription—I see no trace of it, nor do I see the decay of the warlike spirit to which he attributes the necessity of conscription. For myself I do not believe that it is to the decay of a warlike spirit that the unwillingness to enlist is due. I believe that that unwillingness is twofold, in both directions derived from the original constitution of our first standing armies which were recruited by vagabonds and convicts. One consequence has been that the wages of soldiers have always been low compared with those of industrial occupations. Another consequence was the necessity for a system of the severest and the most despotic government, the character of which has impressed itself on our system to this day, but we have been continually modifying and diminishing that character of severity and servitude, and it is in that character that the great difficulty exists. From all that I can learn, it is more often the influence of friends rather than the feelings of young men themselves, that prevents them coming forward, because there is the traditional idea derived from those old days, that a man who enters the Army, sells his freedom. I believe that with some improvement in wages, which the country could easily pay, and allowing for the time necessary for gradual change and development in a body so organized as the British Army, there is nothing to prevent the position of the soldier, becoming as free as that of any other citizen who serves in large organized bodies requiring exact discipline and obedience; and excepting perhaps the prejudice which persists, after the grounds for it have been removed, there is

nothing which will necessarily prevent the Army becoming as attractive in the lower ranks as it is and always has been in the commissioned ranks.

Mr. RALPH KNOX, War Office: I am sure I owe some apology for venturing to put my name down to offer any remarks to this assembly; but it so happens that during the last ten or twelve years I have been more or less mixed up with, and certainly at the birth of, a great number of the changes that have taken place in Army organization, and I think perhaps I may have one or two ideas derived from that experience, and critical of the essay, which may help those present to come to a conclusion upon the subject. The discussions held at this Institution are, it appears to me, very useful, if only for the reason that they elicit the fact, that amongst Officers themselves, on Army questions, there is such an extraordinary difference of opinion. Questions of organization and of Army management, so far as they include strictly military points, one would suppose might form quite an exact science based on experience, and certainly there is nothing in the nature of the subject which ought to admit of so great divergence of opinion; and until there is something more like a unity of view upon these great subjects amongst military Officers, military opinion will never have its due weight, and it is hopeless for us to expect any satisfactory course to be adopted. Those who have to take up these questions and deal with them in a practical way, are entitled to every possible indulgence. For amid the chaos of military opinion, it is very difficult to decide as to what should be done, and to arrive at practical conclusions to lay before the country. That duty is a most wearing and irksome one, and many men have fallen under it, and I am sorry to have to mention to-day that one more is added to that long list of men who have died while at their work in the War Office; for the sad news has just reached us of the death of Colonel Middleton, Deputy Adjutant-General of the Royal Artillery, one of the most laborious, painstaking, earnest, thorough soldiers who ever stepped within the walls of the Horse Guards. In dealing with the question under discussion, I think, in the first place, we ought to ask, what is it we want our Army for? And unless we can come to a satisfactory conclusion as to that, we cannot decide this question in any satisfactory way. It appears to me that, from the fact of Captain Hime having ignored altogether what we want our Army to do, he has fallen into the extraordinary error of recommending conscription. So far as I have been able to study the subject, it appears to me conscription is the only impossible solution to the problem of Army organization. Now, what duties must our Army be prepared for? Is it simply the duty of home defence? It is nothing of the kind. If this were the only problem that had to be solved it would be the simplest in the world. But what is the case? It is clear that Captain Hime has heard of India, because he proposes a separate Army for it. He also has heard of the Colonies, because he proposes a separate Army for them. But is it sufficient to say that there shall be a separate Army recruited for India, amounting to 60,000, and for the Colonies 20,000 men, and so on? By no means. The glib answer with a very large number of Army reformers is, "Adopt separate recruiting for Indian "service." "Return to the system of a separate Army for India." Now the plan never existed of a separate Army for India. A separate 10,000 or 12,000 men existed for India, but 10,000 or 12,000 men is not an Army; and what is the requirement of India at the present time? What number of Europeans have we there now, recruited in this country? 60,000 men, and that 60,000 men is known to be the very minimum force that must be constantly maintained there. This is not a question of what our home defence is. It is also a question of holding India, and that means our power to send out there 30,000 or 40,000 more men at a moment's notice. And can 40,000 more men be sent to India from a "conscript "home Army"? It is not necessary to go into the question of the value of India to this country. We are the conquerors and rulers of India, and we must hold it: but unless we possess the power of sending 40,000 additional men to India at any critical moment, we at once surrender our power to do so. Captain Hime's scheme is the only one under which it would be impossible to provide these reinforcements, and therefore it is utterly unsuited to the formation of an Army for this country. And then what is the case of the Colonies? Have we no duties to perform to them? Why have we withdrawn from colonial stations all over the world the troops that were there? Simply that we might have a strength at home, that

when the emergency arrived, we might pour that whole strength into the particular colony that required it, instead of having our troops at distant stations where they were not available. Captain Hime's plan prevents that being done. He says, a conscript home army is the only possible answer to this question. I say it is the only answer that is not possible. So far as regards foreign service; and now, what is the problem as to defence of these shores. On this point we are sadly in want of a definite military opinion. There is an extraordinary want of unity in the views of military Officers as to what force it is necessary to have on these islands, should we be threatened with invasion, and our fleet be destroyed. Upon that rests the whole question, whether we should have a conscription or not; and it would be an enormous advantage to have some definite conclusion upon it. It has always struck me, the problem ought to resolve itself into a measure of the force which it was possible for any foreign nation to suppose it could successfully land in these islands. That is to say, supposing we had only one soldier, it would be very easy to invade us with ten; so if we had 50,000 soldiers it would be comparatively easy to invade us with 80,000. But it must be admitted that there is a force that it would be a practical impossibility for a foreign nation to embark with a hope of successfully landing upon our shores? Is that a very large or a comparatively small army? I cannot but think, so far as I have been able to look into these things, that the views of some soldiers are very much exaggerated. They seem to think it is necessary to have an enormous body here to prevent the hope of any foreign nation invading our shores. I remember being present at a very interesting discussion in this room, as to the power of shipping men and landing them in this country, and it struck me it was easy to put figures upon paper on mere supposition; but the practical conclusion was, that the embarking of an army from necessarily a few ports, on board enormous ships, sailing them across the seas, and landing them again, is by no means such an easy thing as on paper it may be made to appear. Now supposing we may say it is a very difficult thing indeed for 150,000 fully equipped and armed men, with all the appliances required by modern warfare, to be embarked and landed on these shores, what force should we maintain here that would compel a foreign Power to decide that at least that number of men must be sent, or no good would come of the expedition? On this question entirely depends the solution of what we want in the way of an Army, and how it must be raised; because if it be the case that 120,000 soldiers, *i.e.*, four *corps d'armée* of 32,000 men, distributed on strategical points in the country, each completely equipped and always ready for service, if that force is sufficient to deter a large expedition with any hope of success from coming upon these shores, then the long service system, pension, and recruiting, similar to that which was in vogue subsequently to 1847, would be perfectly ample to provide that force within our present expenditure; that is to say, we might have 30,000 men more than we now have in this country—making up 120,000 men, completely equipped, cadres always full, old soldiers, pensions, and everything that the old-fashioned soldier admired most, for the same money that we spend now. Because, I assume that you would get rid of your militia, volunteers, and auxiliary forces, simply for the reason that you do not want them; because, by this hypothesis, 120,000 men, perfectly drilled, completely equipped, and always ready, is sufficient to protect this country. But if, on the other hand, 120,000 men are not sufficient to deter a foreign country from sending an army to invade us, and it is necessary to maintain large Reserves, because it can be shown by military evidence that 200,000 men or 300,000 men can be landed, then you must have a very much larger Army to defend these shores, and they must be as thoroughly trained as those men who are likely to land; that is to say, suppose 300,000 men can land, you must have 300,000 men, equally well drilled, to go against them, and it is no use thinking the militia drill and the volunteer drill, as it at present exists, would be sufficient to back up your force of 100,000 regular soldiers. You must resort to something which will make every one of your men, man for man, equally well trained with those soldiers who may be serving in the invading armies. These are the ideas that suggested themselves to me on reading Captain Hime's pamphlet; and I hope I have shown, with a fair amount of success, that Captain Hime's prescription of universal conscription is the only system which is inapplicable to the requirements of the country.

Lieut.-General the Hon. Sir ALEXANDER GORDON, K.C.B.: The last speaker mentioned the want of unanimity among military Officers, but I think military Officers here present have shown great unanimity in the condemnation of Captain Hime's proposals. It appears to me Captain Hime sat down to write an essay upon recruiting the Army, and finding it more difficult than he expected, he has written an essay on the origin of military service in the Army. His essay is a very interesting *résumé* of what has occurred in the last 100 years, but he entirely fails to grapple with the question before us, which is,—"The best mode of obtaining recruits for the Army "serving in India and the Colonies." There is not one single allusion in Captain Hime's essay to this subject. It would be very interesting to this meeting if it could be informed of the grounds upon which this essay was considered so superior to the seventy-eight other essays as to obtain the gold medal, because it has avoided the real question which the Council submitted to the Officers of the Army.

The CHAIRMAN: I think that that is not a question which we can answer.

Captain LOFTUS FOX, Longford Militia: I shall not venture to offer any opinion upon the relative merits of the systems of voluntary and compulsory service, but where a question of Reserves is under consideration I may, as a militiaman, be permitted to state my conviction that we ought not, and that we cannot lose sight of the militia. It must be remembered that though we have a promise of a reserve from the Army, we have at present seen very little of that Reserve, and that it will be some time before that Reserve can be put into working order. The new system of organisation cannot be improvised in a moment, it must be a matter of time, and in the interim we have no Reserve except the militia to fall back upon in case of an emergency. But, further than that, let us suppose that the Army Reserve, as contemplated under Lord Cardwell's system, was in full force, supposing the 60,000 men, to which I believe it is limited, were all there, what would be our position in case that emergency took place? Supposing a foreign war, or a foreign invasion, what would be the first result? Why, that 58,000 or 60,000 men would be immediately required to fill up the existing battalions to a war footing. Where then would there be any Reserve but in the militia? and is it prudent, under those circumstances, to throw away what you have, before you have anything to take its place? Taking the conscription principle to be the one for the future, that would still be longer bringing about than the present system of Lord Cardwell, because it seems to be generally agreed that this country is not at present prepared to adopt conscription, and if we are at any time to come to it, it must be at some distant period, and what are we to do in the meantime? Besides which, I think the very system of fostering and encouraging the auxiliary forces, supposing we be, by the course of events, obliged to put ourselves in harmony with the systems prevalent now on the continent, would tend more than anything else to smooth the way for its adoption. What better training or education could there be for the people to adopt willingly the system of conscription than to make men of every class acquainted with the principles of soldering, not only those professional soldiers who make it their business of life, but also of other portions of the community (and they are becoming more numerous every day) who have not only the leisure but the inclination for intermittent soldiering?

Having, I think, shown that we have at present no Reserve but the militia to depend upon, and that for many years we shall have no Reserve that we can count upon, and even if we had a Reserve, that we could not do without the militia, I think the first thing we ought to do, is to try and improve that militia as much as we possibly can. It can be done very easily, because it involves no new principle whatsoever. You have the militia cut and dried ready to your hand, and above all, willing. I was very much pleased to hear from the gallant Officer who spoke before me of the willingness with which all ranks of the militia (Officers and soldiers) come up at their annual training. I can corroborate that statement, for I come from Ireland, where the population is more restless, more given to wander and to emigration than the people of this country; and, after nearly twenty years' service in an Irish Militia Regiment, I am amazed at the strong musters it makes year after year. The way men turn up, I may say from the ends of the earth, is most creditable, the number of what may be termed wilful absentees is small—in my own company they have been very few; I do not think for several trainings I have had more than five or six

men absent. That speaks strongly for the fact that if you are to have a Reserve, why should not you use the materials ready to your hand, and that are willing to be used. Then comes the question, not only are they willing, but are they efficient? On that point I am afraid I cannot give a satisfactory answer—but it is not our fault. It is not the fault of either the Officer or privates of the militia that they are not more efficient. We cannot soldier a day longer than the term prescribed for us; but that we do not object to increased efficiency may, I think, be proved by the fact that though the term of training for regiments has been increased from twenty-one to twenty-seven days, and for recruits from fourteen days to two months, we find the militia coming forward for their annual training more freely now than they did formerly. That being the case, what can be more obvious than that the first thing to do is to try and put your militia upon a satisfactory footing. It is not only easy to do, but it is the cheapest way in which you can raise your Reserve. In a paper read in this Institution some years ago[1] I laid down two points, that you must improve the training of the men and the education of the Officers. I ventured to suggest a system by which the third part of the militia should be called out annually for three months, a third portion for two months, and another portion for one month; in other words, every militia regiment would triennially get three months' training. I do not say that that would make us perfect, I only throw it out as a suggestion; military men are more competent to deal with it than an outsider like myself, but some step should be taken in that direction. Surely no one supposed that twenty-seven days' training, or any annual repetitions of twenty-seven days' training, let them be repeated *ad infinitum*, would ever make a man a soldier; and if it did, if twenty-seven days, or any number of repetitions would, what is the use of your Army, because then soldiering would be an inspiration, it would not be a science? You do not require continuous training if that could be done, so, consequently, some step in that direction must be taken, if the militia is to be made useful. One word more, and really this is after all the most important question we have to deal with in the whole of this discussion, and it underlies the efficiency not only of the militia but of any Reserve, and that is the importance of the military education of the Officers. There has been during the last few days a good deal of prophecy going on in this assembly, and I regret to see the prophets, generally speaking, have met with very little favour. I think I can quote to you a prophecy which will obtain your approbation for two reasons; first, because it has been fulfilled; and secondly, I think the name of the prophet itself will be quite sufficient to secure your respectful attention. I allude to an extract from a letter written, years before those continental systems came into vogue, by Sir John Burgoyne, who said, "All the propositions hitherto advanced have in view only the improvement "of the private soldier of the Reserve, when what is of more importance is, a "Reserve of good Officers and Non-commissioned Officers, for clearly a regiment of "very inferiorily trained soldiers, under a complement of good Officers and Non-"commissioned Officers, would be far superior to one of first-rate trained soldiers "under inefficient Officers and Non-commissioned Officers. The first would rapidly "improve, while the other would as rapidly deteriorate."

Then the question is, how are you to provide an improved class of Officers? A gallant Officer, who spoke the other day, proposed that the militia should be officered by the Army Officers. I can scarcely suppose him to intend that men on full pay were to be sent altogether to officer the militia, because I cannot see, merely, as I said before, as an outsider, where they could be found. You require some 4,000 Officers; and it strikes me the active Army can scarcely supply 4,000 Officers to officer the militia. I rather suppose he referred to men who had been in the Army at some time; and, to a certain extent, I venture to express my humble opinion that that would be a very good idea, and, in fact, it is already carried out to a certain extent. Out of 3,000 Officers in the militia, we have something like 750 who have been in the line, and most of these, I am sure, are a very great acquisition to us. They are men, generally speaking, who entered the Army, not with the intention of remaining there any length of time, but they went in as gallant

[1] "Our First Reserve," by Captain L. Loftus B. Fox, Royal Longford Rifles. Journal, Vol. XIII, page 1. 1870.

gentlemen of England do, knowing that it is a good school for them, and they are of the greatest possible use to us. But they are not sufficient in numbers to officer the whole of the militia. And then it would come to this, are you to offer a premium? are you to say that no one is to get a commission or to have the control or direction in any way of a militia regiment except a man who has been in the Army? Are you to go and hunt up all those men who, for excellent reasons of their own, having once put their hand to the plough, looked back? I can scarcely believe that is a desirable way of officering the militia. And beside that, allowing that we must have a military element, and I should not be at all sorry to see it increasing in the militia, I do not think that what I may call the civilian element ought entirely to be eliminated. I say so because I think men will work better, I may say that I find it, that half-trained men will work better under the supervision of military men, such as adjutants and ex-lieutenants, or by having also Officers who can have more of a fellow-feeling for their infirmities, and who, like themselves, are not professional soldiers. I think that would go a long way with them. I think it would encourage what is a most wholesome feeling in the present day, namely that every man owes military service to his country, be he civilian or be he professional soldier, and that whenever he can get the opportunity to serve his country he ought to do it.

This is a large subject, and I have not time to enter fully into it now. I will only venture to add one suggestion, it is this—make it compulsory on every one who seeks a commission in the militia, that he shall have a twelve months' training, in a military depôt, or with a line regiment before he is gazetted, or serves with any militia regiment. Do that, and you will have gone a long way towards making the militia an efficient Reserve.

Captain NEEDHAM, R.M.A.: I had intended to make a few remarks, speaking as an Officer of the Royal Marine Forces; but I find that Colonel Fielding, in his allusion to that corps, has forestalled me in much that I was going to say. I will, therefore, merely supplement that part of that Officer's speech in which he spoke of the comparative facility with which recruiting sergeants of the Royal Marines picked up recruits. That there is no great difficulty experienced in obtaining the number of men annually required for our forces is perfectly true, but I believe it is equally true that 15 or 20 years ago, men were even more easily obtained; and yet the conditions of service in the Royal Marines have not changed since that time. Men enlist for the same number of years now as then, obtain the same pensions on discharge, and during their service receive, if anything, rather better pay. Why then this falling off in the number of recruits? It may be partly owing to the general rise of wages in civil life; but I think the main reason is to be found in the alteration which has been made in the system of payment. Formerly the great bulk of the pay of a marine embarked, was kept back until he returned to head-quarters and, as a marine serving on board ship receives a free and ample ration, a man would frequently take on furlough with him, after a three or four years' commission, £60 or £80, or even a yet larger sum. Now, a marine is paid the greater part of his pay on board ship, from time to time, consequently he no longer takes with him when he goes to visit his friends after his cruise at sea, the large sum that he did formerly, and it is owing to this fact that I think that the marine service is no longer so popular as it was, among the classes from whom we obtain our recruits. What I would deduce from this experience is, that some such system as that recommended by Colonel Cox yesterday, and by Colonel Fielding to-day, some system of perhaps not paying the men more highly than at present, whilst they are actually serving with the colours, but of giving them a handsome remuneration when they are at home with their friends, will be found the most effectual way of providing the necessary supply of recruits for the Army.

The CHAIRMAN: We have now exhausted the list of speakers. We have had a very full discussion, and on the whole I hope the meeting and the profession generally will feel it has been a very creditable discussion. I will not enter into the question myself further than this. It was mentioned by Mr. Knox, of the War Office, that there was a great deal of uncertainty from the variety of opinions in the Army upon various points connected with the Army; but I think on two questions there is no uncertainty; one is that the actual recruits, the actual body of the rank and file, are those who form the foundation of the Army; they are the people, of

whom the Non-commissioned Officer up to the General Officer are the mere staff to arrange the effective fire and the work in short, of those private soldiers in the ranks. If that is the case, we want for the very foundation of the Army, the best men that you can get for that purpose. Now if I am to take the general result of the 79 essays which three of us read lately, there is no doubt we do not get the man that is efficient for our purpose. I think there was scarcely an exception in the general tone of the whole of those essays, and coming from all ranks, that we do not get the man that is most serviceable for our purpose. Now if we do not get the man that is most serviceable for our purpose, we get a most expensive article. I ask any Officer to trace the career of one of these weakly lads of 18 from the time he receives the money of the Crown till he goes out on foreign service; he is there put into hospital, probably remains there for some time and comes back again invalided. During the Indian Mutiny I remember reading of men who were sent out and were at once put into hospital, and out of a detachment perhaps of twenty, one-third would come back never having done a day's real soldiering. That is the case in all expeditions wherever there is hard service. If we could, as a general body of Officers, bring to the notice of the Government, by the discussions that take place here, the money value, as well as the value of the credit to the Army and Nation, of getting efficient men, and no others, for the staff to act upon, we should then be doing a very great service to the authorities in this country. I look upon it that one object of these essays and of the opinions expressed here, is to impress that in the strongest possible way upon the Government of this country. I hope, therefore, that this being a place where we can express our opinions very freely without any restraint, except that imposed on us as Officers and Gentlemen, towards the Government and Crown we serve, the Government will really pay attention to that which is the general feeling of all Officers in the Service from the highest to the lowest, namely, that we must start with good material in the ranks, in order that then the Officers may be able to do properly the duty of the Army.

I do not know that there is anything I need further refer to. I am tongue-tied rather with regard to the question of the Prize Essay on Recruiting, but we three referees gave the subject our best consideration and came to that decision; I do not go into the reasons why or wherefore, but that was the settlement. I think the Prize Essay is a very able pamphlet, although some of us may not quite agree with many of the terms employed in it. We may now consider the meeting dissolved and the question closed.

General STANHOPE moved a vote of thanks to General Sir William Codrington, for his able and courteous conduct in the chair, and the motion was carried with acclamation.

Evening Meeting.

January 18, 1875.

Vice-Admiral Sir FREDERICK W. E. NICOLSON, Bart., C.B., Vice-President, in the Chair.

NAMES of MEMBERS who joined the Institution between the 1st and 18th January, 1875.

LIFE.

Strange, Charles V., Lieut. R.N.
Betty, J. F., Major R.A.

ANNUAL.

Glover, Sir John H., G.C.M.G., Captain, R.N.
Watson Henry W., Lieut. late R.E.
Barrow, Charles T., Lieut. 26th Regt.
Preston, B. H., Major Madras Staff Corps.
Hogg, John R., Captain R.E.
Pitcher, Duncan G., Captain Ben. Staff Corps.
Polkinghorne, Stewart, Lieut. R.M.L.I.
White, Chas. W., Lieut. West Kent Mil.
Kinloch, Geo. A. H., Capt. 13th Regt.
Reid, Sylvester, Lieut. 11th Regt.

ON THE COMPARATIVE MERIT OF SIMPLE AND COMPOUND ENGINES.

By G. B. Rennie, Esq., M.Inst.C.E.

Having been invited by the Council of this Institution to read a paper "On the comparative merit of simple and compound engines," I will endeavour to lay my views before you with as few technical expressions as possible. That such a subject cannot be treated altogether free of such terms, and as I expect that several members present here to-night are of the Navy, who have mostly a knowledge of the construction and management of the propelling machine on board a man-of-war, I trust your indulgence in allowing me the use of a few professional words.

It will *first* be advisable to understand what is meant by the terms simple and compound engines (those being the words given by your Secretary). As regards the "simple engine," it may be either taken as the simplest type of steam engine in ordinary use, such as with a single cylinder, without separate appliances for "cutting off" the steam to allow it to expand more than is due to the ordinary "cut off" made by the slide valve, and to discharge the steam so used direct into the

atmosphere; or it may be considered an improved form where the steam is expanded to its utmost by the use of separate expansion-valves, or by utilising the steam discharged by heating the feed water, or improving the draught of air in the furnace, by turning the discharged steam into the chimney by what is known as the "blast," or by condensing the discharged steam either by direct contact with cold water, or what is known as surface condensation, and finally taking advantage of the steam so condensed in creating a vacuum by the application of an air-pump to discharge the air and condensed steam. Though all these forms of engine, each of which is a gradual improvement on the efficiency of the machine, may be taken as the "simple" marine engine, yet I am inclined to think the latter, which may be considered as the most improved type of using the steam advantageously in a single cylinder, so as to get the greatest power out of a given quantity of evaporated water, is what would be most interesting to you to form a comparison with what is called the "compound" engine.

Secondly. The compound engine, in contradistinction to the ordinary or simple engine, has two or even more cylinders for using the same steam, that is, after the steam has done its duty in one cylinder, it is discharged into another, and in some few cases again into another, until the maximum effect is obtained out of the steam by its expansion.

The usual form of compound engine is to have only two cylinders in a complete machine, the two cranks being placed at right angles with each other, as with the "simple engine," but they are not unfrequently made with four cylinders, viz., one large and one small to each crank. The proportion of the large to the small cylinders in either system depends on the steam pressure used, the amount of its expansion, and whether especial mechanical arrangements are made for cutting off the steam by independent valves, or merely allowing the steam to expand, according to the relative volume of the two cylinders. The usual proportion is, however, three or four to one.

Examples of the first arrangement are the "Briton" and "Tenedos," similar ships of 350 nominal horse-power. The results of the trials of these two ships may be said to have commenced, the compound system being adopted in the Navy, though the "Sirius" and "Spartan," of similar horses' power, had been tried some time previously. These two are of the second type of compound engine above described, each crank having a large and a small cylinder working on it.

The results of the "Briton's" trials are published in the "Transactions of the Society of Naval Architects," from a paper I read at a meeting of the Society held in March, 1871 (Appendix A). The consumption of coal at full power was slightly under 2 lbs. per indicated horse-power per hour, the best result being obtained when working about half power, when only 1¼ lbs. was burnt per indicated horse-power. A nearly similar result when working full power was obtained with the compound engine for driving the new pumping machinery at Chatham Dockyard. Arrangements were made for measuring all the steam used in the engines by discharging it, after it was condensed into water, into two tanks. The power by the indicator was taken every

ten minutes. The total time of working the engines was a little over 3½ hours, and it was found that 18·92 lbs. of water were used in the shape of steam per indicated horse-power per hour; and as the coal used, viz., "Fothergill's Aberdare," has, according to Admiralty experiments, an evaporative power of 9·73 lbs. of water per lb. of coal, this would give (taking the steam used as the basis of calculation) a little under 2 lbs. of coal per indicated horse-power per hour.

I have here a table of the comparative consumption of coal of different kinds of engines. This comparison was made a few years ago, and from further observations I think it is, on the whole, a pretty fair one (Appendix B).

There may be many engines of each kind which may consume more or less than stated; but supposing them to be all under the same usual conditions, both as to manufacture, kind of coal, and other circumstances, I believe it is not far from correct.

Since this table was made out, I have had a most satisfactory opportunity of comparing the results of the coal consumed between the ordinary or simple injection engine working with 25 lbs. steam in the boilers, and the same engine, after being compounded, working with about 55 lbs. steam in the boilers.

The "Minia" was a screw steamer of 200 nominal horse-power. The cylinders were 54 inches diameter, with a stroke of 3 feet 4 inches. The number of revolutions of the screw propeller was about 60 per minute. The engines were the ordinary overhead construction, with injection condensers and boilers for working with 25 lbs. steam pressure. The average consumption of coal was at the rate of 33 tons per 24 hours, with a maximum consumption at full power of 45 tons per diem. The engines were "compounded" by my firm, by placing small cylinders of 27 inches diameter on the top of the existing cylinders. A surface condenser was also added, and one of the existing air-pumps was converted into a cold water circulating pump. Four new boilers, adapted for 60 lbs. working pressure, were also supplied. The rest of the engine, including the screw-propeller, remained as before, and the result has been that the average consumption at sea has been reduced to 17 tons per diem (equal to about 2¼ per indicated horse-power), with a maximum consumption of 24 tons when working full power, and the revolutions of the screw propeller, and consequent speed of ship, has been slightly increased. That is, the coal consumption has been reduced nearly one-half since the engines have been "compounded."

I may also cite another example of the comparison between the ordinary injection engine and a new compound engine which had been substituted for it. The "Pera," a screw vessel belonging to the Peninsular and Oriental Company, had formerly vertical geared engines of the injection type, which were considered very economical in their day.

The nominal power was 450 horses, and gave an average yearly speed of 10·4 knots per hour, with a consumption of 43 tons per diem. New engines were placed on board, of the compound type, and the ship ran from Brindisi to Alexandria, with the Indian mails, making an average

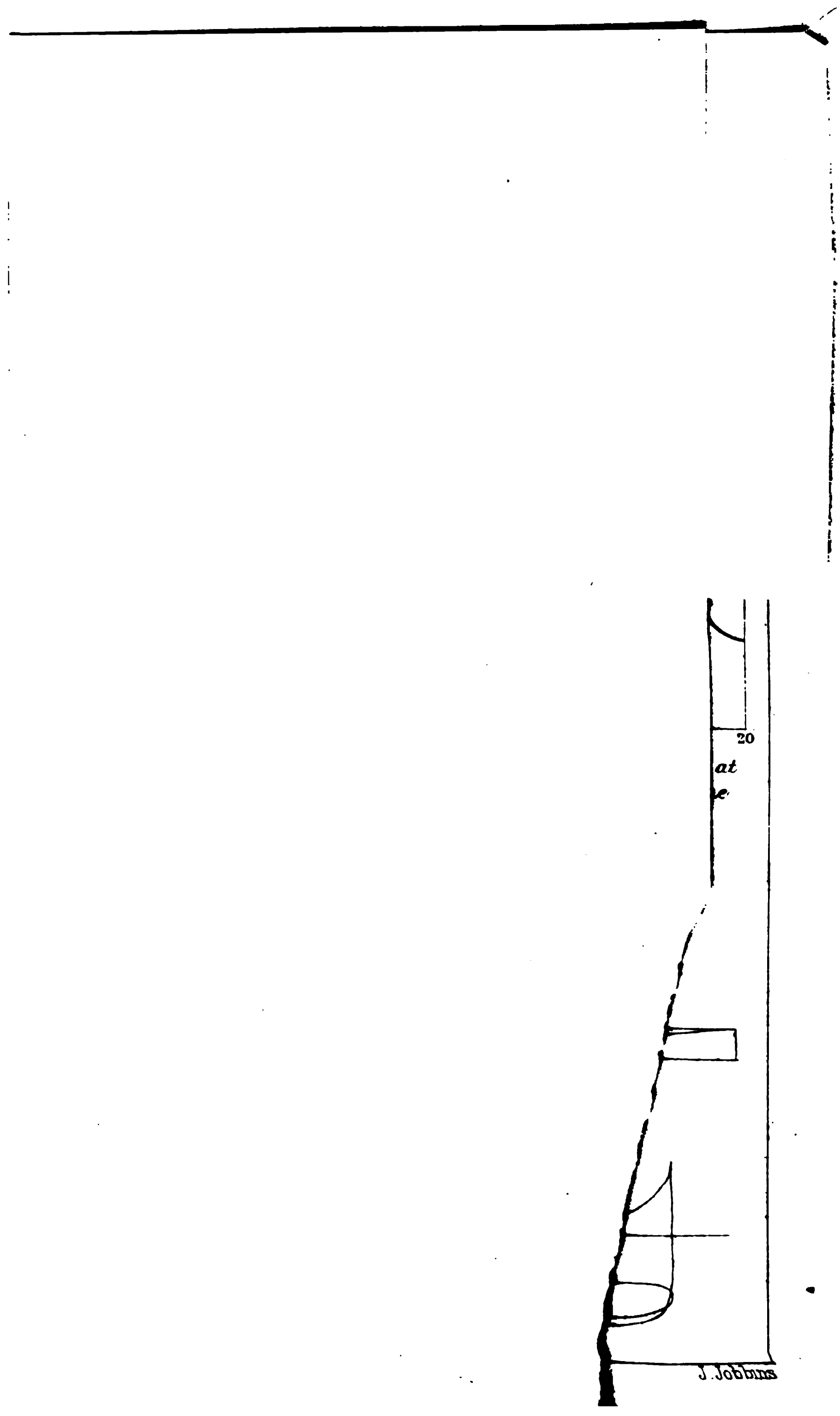
somewhat over 10½ knots, with an average consumption of about 24 tons of coal per diem. This is an example where both engines are by the same makers, with equally good manufacture, and the same engineer management on board, and the ship navigating the same seas.

As an instance what can be done in making a long sea voyage entirely under steam, with a small-sized ship with compound engines, I may mention that of a dredging vessel of 160 feet in length, and 28 feet beam, fitted with twin screws and compound engines of 70 nominal horse-power, having made the voyage from London to Buenos Ayres in 46 days, stopping only once, namely at Madeira, to fill up with coal; that she steamed a distance of about 5,000 miles, between Madeira and Buenos Ayres, in 36 days, without taking in fresh coal. Had the ship had the old class of engines, she would have been obliged to have made the voyage under canvas, or to stop at intermediate ports to take in coal.

It will be understood that such a radical change in the propelling machine of a ship, enabling her to be steamed nearly double the distance with the same weight of fuel, is so important in its effects on ocean steam navigation, that one can hardly be surprised at the demand there has been in the mercantile world for ship engines of the new type; but the increased number of steamers and accelerated trade thereby, so increased the demand for coal, which was not supplied in the same rapid rates as the ships and engines, and so augmented the price of it, that the money equivalent from the reduced amount of coal used in each ship has not been realised to what was expected, and has unfortunately now caused a considerable stagnation in the shipping trade.

The improved result in point of consumption of coal of the compound engine over the old type engine, is not due entirely to making the steam do duty in two cylinders instead of one, but to the different conditions in which the steam is used, viz., to the greater boiler and initial pressure used in the cylinders, and to expanding it to a much greater extent than formerly, in order to get the full duty out of it. The question of the relative advantage of expanding steam in one cylinder or two has been a controverted one with engineers for many years, especially as regards land engines, where the higher pressures had been more frequently used; but I think it is now pretty well agreed on all sides by those who have studied the subject, that where the pressure of steam, amount of expansion of same temperature, and dryness being also alike, and with equally good manufacture and superintendence, that the fuel consumed per indicated horse-power, is practically identical in both systems.[1]

[1] That is, when the pistons are of so good a construction as to be practically tight; but should that not be the case (which is not uncommon) I think it highly probable that with the simple engine, with 60 or 70 lbs. on one side of the piston and a vacuum on the other, a much larger consumption of steam and coal will take place than with the compound cylinders, where the pressure is at the boiler pressure on one side of the piston, and some 5 or 10 lbs. above atmospheric pressure on the other; moreover, should any leakage of steam take place by the high-pressure piston, it will have a chance of being used in the low-pressure cylinder before being discharged into the condenser.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We have adopted the compound engines for many years; in 1842 we supplied them for Messrs. Cubitt and Sons', London Dock pumping engines, Royal Arsenal, and many others. The engines on this plan are usually called "double cylinder beam engines," and work with about 60 lbs. in the boilers; our preference for this engine being that the strains were more uniform and less severe, and the rotatory motion more equal. The consumption of coal I find in referring to some old examples, was about $2\frac{1}{4}$ lbs. per indicated horse-power, or about the same that is realised in a good compound engine.

It is always a difficult matter to get good examples of a fair comparison between two classes of engines, but as regards land engines, I may quote the trials between the simple and compound engines made at the New River Waterworks Company, where, I believe, as far as consumption of coal was concerned, there was practically no difference in the two systems. As regards marine engines, the comparative trials between the "Goshawk" compound and "Swinger" simple, with two cylinders of equal size, will be in the recollection of many, but it may be well to state the leading particulars. These two vessels were of like tonnage and horse-power, the trials were of six hours' duration, and took place at the same time and place. The average power of the "compound" was 374·2 horses, at a consumption of 2·6 lbs., and the "simple" was 364 horses, at 2·61 lbs. per square inch. After the trials to test the coal were completed, the speed of each vessel was ascertained on the measured mile, which showed the "compound" vessel to be making 10·419 knots, whilst the "simple" only made 10·14 knots. The greater speed of the former may probably be due in part to a slight excess of engine power; but I am inclined to think that more is due to the more uniform distribution of the power round the path of the crank, and that that machine which gave the more steady and uniform motion to the propeller, pushed the ship the fastest through the water.

I have made two diagrams (Plate V) showing the pressures in tons at right angles to the cranks (tangential pressure), at 20 equally divided points in the circumference of the circle of 9 in. radius (Fig. 2). These pressures are calculated from copies of diagrams taken on the trials, the length of the connecting rods being also taken into account to get the true pressures at each successive point of the path of the cranks. It will be observed that in the diagram of the "compound engine" the tangential pressures varies from 4·29 tons to 13·56 tons, or the highest is 3·1 times that of the lowest. In the "simple engine," it varies from 4·60 tons to 21·12 tons, or the highest is 4·59 times the lowest; and I am inclined to think that the greater speed of ship with the compound engine is due to there being less variation in the pressures throughout the revolution of the screw propeller.

The compound engines of the "Briton" I found to be even more uniform than those of the "Goshawk"; the pressures in that case varied from 7·91 tons to 17·16 tons, or the highest was only 2·1 times that of the lowest.

I believe the question of a uniform tangential force is of more importance than is often considered, both for propelling the ship, as well as for the less liability to rupture of the different working parts,

which rupture is more often due to suddenness and change of strain than to a constant steady pressure.

Taking the above named pressures in each class of engines, I found by keeping the shafts and other working parts of equivalent strength, which would probably give a total weight of somewhat under 5 per cent. for the pressures they had to sustain, that the simple engine was about one-tenth heavier than the compound engine, of course, irrespective of boilers, which would be common to both.

To show how important it is to take into consideration the tangential forces in the crank-path, I found, in making different calculations for finding the best position to place the cranks of the compound three cylinder engines of the "Boadicea" and "Bacchante," of 5,250 horse-power each (Plates VI and VII),[1] that if the cranks were placed at equal angles between them, the shaft should be 18 ins. diameter, but if placed with the two low-pressure cranks opposite to each other, and the high-pressure crank at right angles to them, that the shaft need not be more than 16 ins. to be of equal strength to transmit the same total power.

The *simple engine*, or engine with two cylinders of the same size, working with a pressure of from 60 to 70 lbs. direct on the pistons, has been tried in more than one Transatlantic Company. One of them had, I believe, four vessels with such engines, but it was eventually found necessary to reduce the pressures some 20 lbs per square inch in consequence of the crank-shafts continually breaking, but, according to the usual mode of calculating the strain on the shafts, they ought to have been amply strong enough for the intended pressures, and I can only account for it by the sudden and irregular strains on the shafts due to the high initial pressure and early "cut off."

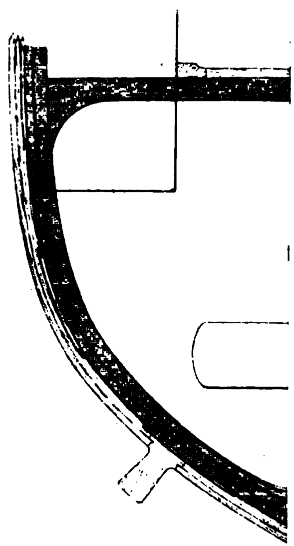
It has been supposed by some that the weight of the screw propeller is sufficient to act as a fly-wheel to give an equitable rotative motion in propelling the ship; but I think that any one who has observed the working of a powerful engine on board ship must have seen that such is not the case: there is usually one part of the revolution of the shaft that appears to have greater power exerted through it, and it is felt in the motion of the ship. It has always appeared to me that I have felt less motion with the compound engine than with the old type.

One objection that has been used with reference to the compound engine is, that the low pressure cylinders in engines of great power become of so large a size as to render the castings excessively heavy, and that many of them have cracked after being in use. This difficulty is in a great measure obviated by making an inside liner of a separate piece from the body of the casting, and forming a space between them for a steam jacket, instead of casting the whole in one. The system of having two low-pressure cylinders to one high-pressure cylinder, as in the "Boadicea," or by having two low-pressure cylinders and two high-pressure cylinders, as in the "Minia" type, also prevents any objection on that score.

It has been sometimes asserted that the increased surface subject to radiation in the compound cylinders has tended to a loss of heat; but on

[1] The Institution is indebted to the Institution of Naval Architects for the originals of these plates and of Fig. 3, Plate V.

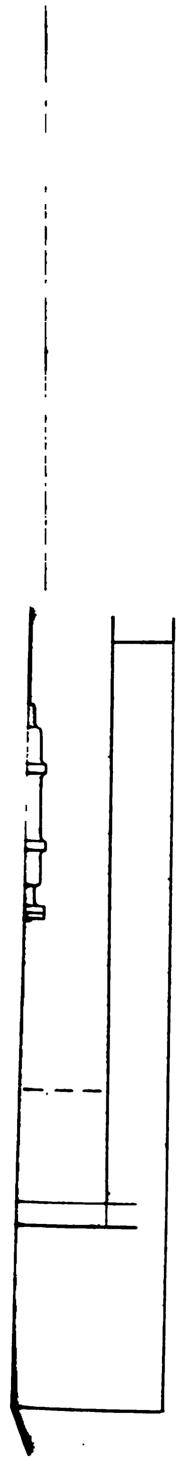
To illustrate M.r G. B. Ren



Diam.r of H. P. Cylinder 73 ins.

Diam.r of L. P. Cylinder 92 ins.

Length of Stroke 4' 0"



the other hand it must be remembered that the increased size also gives an increased surface of steam jacketing to warm up the steam inside the cylinder.

Some interesting particulars have lately been published with reference to the trials made with the engines of the United States' Coast Survey steamer "Bache." These seem to have been made with and without a steam jacket on the compound cylinders compared with the same pressure of steam (80 lbs. per square inch), used in a single cylinder alone, also with and without the steam jacket. The high-pressure cylinder was about 16 inches diameter, and the low-pressure 25 inches, stroke in both being 2 feet. The results, *without steam* in the jackets when working as a compound engine, appear to indicate that there is not any material difference in the consumption of steam and coal per indicated horse-power by using the different grades of expansion, which varied from 5·6 to 9·14 times total expansion, with a consumption of coal only varying from 2·54 lbs. to 2·6 lbs. per indicated horse-power per hour. Whereas when the single large cylinder alone was used without the steam jacket admitting the steam pressure of the boiler, viz., 80 lbs. per square inch, direct on to the piston and "cutting off" by means of an independent valve, the consumption per indicated horse-power appears to increase when the expansion of the steam is greater, that is, with a ratio of expansion varying from 5·3 to 11·8 times. The coal per indicated horse-power varies from 2·874 lbs. to 3·84 lbs.; but when steam was admitted into the jackets (and selecting two trials from each series of experiments which more favourably compare), the compound cylinders had a ratio of expansion of steam of 5·7 and 9·19, with a corresponding consumption of coal of 2·23 and 2·26 lbs. respectively, and with the single with steam in the jacket with an expansion of 5·1 and 8·57 times and a consumption of 2·53 and 2·638 respectively, that is, the result is rather in favour of the compound engine in point of consumption of steam and coal. That this is due to any advantage of expanding the steam in two cylinders instead of in one I am not inclined to think, but probably to some difference in the vacuum, coal, or stoking, besides the slight difference in the expansion, or to leakage of steam by the piston.

The initial pressure on the large piston, after the steam has done its duty in the small one, is given as 18·99 lbs. (say 20 lbs.), but when the steam is acting direct on the large piston for working on the simple plan, then the initial pressure is as high as 90·14 lbs. (say 90 lbs.), the average revolutions in the first case being 48 and the second $46\frac{1}{2}$, the horse-power being 77·45 and 74·6 respectively.

It may therefore be said with the same horse-power and same number of revolutions that the total pressure on the compound cylinder would be 1 and on the simple cylinder $4\frac{1}{2}$; but supposing—to fairly represent the difference—there were two cylinders of half the size to compare with the two cylinders of the compound engine, the proportion of the pressures would be as $2\frac{1}{4}$ to one, and the working parts would have to be increased at least in corresponding proportion to be of equal strength to the parts of the compound engine.

In actual practice in marine engines, it may happen that the smaller

diameter of the "simple engine" may be still further reduced, in consequence of the form of the ship admitting of the cylinders being placed more in the wing, which may still further enable the diameters to be reduced and the stroke increased in proportion.

It seems to me that the compound engine must be looked on in the light of a most convenient mechanical arrangement for working with a high pressure of steam and great expansion; and should very much higher pressures than 60 or 70 lbs. per square inch come into use—and I believe it has been proposed to make some engines for the navy for working with from 250 lbs. to 300 lbs. pressures—it seems to me that some system of compound must of necessity be adopted, and that with three or more cylinders in lieu of two, as is now usual.

The following, I therefore think, may be the summary of the comparative merit of the simple and compound engine:—

1st. With equal amount of pressures, expansion, dryness of steam, the coal consumed will be practically identical in both systems, supposing the pistons tight.

2nd. When equal power is obtained, the working parts of the simple engine will have to be heavier than the compound.

3rd. The strains on the compound engine being more uniform, there will be less liability to fracture in the working parts.

4th. The simple engine with two cylinders of the same size will have the advantage of having fewer pieces of spare gear to stow away.

5th. The simple engine having each cylinder independent of the other can be more readily worked with one engine than with the compound engine, should one engine be disabled.

6th. For the same power of engine, it is probable that a greater speed of ship may be obtained with the compound engine than with the simple engine.

7th. If much higher boiler-pressures come into use than are now usually worked, the compound engine will have to be exclusively adopted, on account of the better mechanical arrangements which can be made for working with a high degree of expansion.

APPENDICES.

(A.)

Particulars taken from the Reports of the Official Trials of the Compound Engines of H.M.S. "Briton" for six hours' steaming.

Date of Trial.	Mean speed of ship in knots.	Pressure of steam in engine room.	Revolutions per minute.	Indicated horse-power.	Coal per horse-power per hour.	Time of steaming with 240 tons.
2nd June	12·767	51·91	92·649	2,018·3	1·98	5¼ days
10th June.............	10·026	50·00	67·308	660·58	1·3	26 „

(B.)

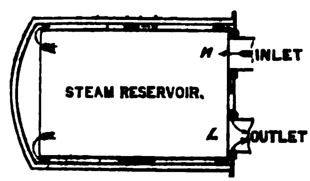
Comparative Consumption of Coal of different Types of Engines.

Type of Engine.	Per H.P. per hour.	Tons per diem.	Days and hours steaming with 240 tons of coal.	
			Days.	Hours.
1. Improved compound	2½	48	5	0
2. Ordinary type with surface condensers and superheaters	3½	75	3	4
3. Ordinary injection	4½	97	2	11
4. High pressure	6	129	1	21

The CHAIRMAN: I understand there are several gentlemen here who have given much attention to this subject. We shall be happy to hear any observations they have to make.

Mr. COWPER: I do not wish to occupy much time, as I think Mr. Rennie has already explained the principle of compound engines very thoroughly; but I suppose I must take some little of the credit of the "Briton," seeing she is under my patent by the arrangements of the reservoir for the steam. Of course, in a paper like this, it is impossible to go fully into the details. I may, perhaps, explain the arrangement

COWPER'S ARRANGEMENT.



of the reservoir, which is that of a steam-jacketed vessel with high-pressure steam from the boiler in the jacket, and so far is the same plan that I introduced many years ago, but my particular arrangement of the reservoir as in the "Briton" is peculiar. There is first the steam-jacket round the outside of the reservoir, but the steam from the high-pressure engine passes into the interior of a hollow vessel or lining inside the reservoir, so that when the steam goes from the high-pressure cylinder where it has been partly expanded, it goes into the reservoir at "H," but when it comes out, it does not come out from the same pipe, but from behind the closed end of the internal lining; so that the steam has to pass all along in a thin film about as thick as your hand, between the internal lining and the steam-jacket out at the pipe "L," and so gets warmed up. Therefore, without any valves, the steam is caused to pass into the reservoir and is not then superheated, but it is superheated before reaching the low-pressure cylinder. You have, thus, an opportunity of warming up the steam during expansion, and I believe it is owing to that, that so low a consumption as 1·3 lbs. of coal per horse-power per hour has been obtained with the "Briton" at a 10-knot speed. It is the lowest consumption that has ever been obtained. I quite agree with Mr. Rennie in reference to placing the cranks at right angles, and I am glad to see he has so carefully gone into the question of the com-

parative amounts of rotative power, when two low-pressure cylinders of moderate size are used, instead of a large one, to work with one high-pressure cylinder with its crank at right angles to them. It was owing to my having investigated the rotative power, &c., very thoroughly before 1862, that caused me to advocate the cranks being placed at right angles. The various rotative powers are very strongly shown by the diagrams I then made, as below :—

FIG. 1.

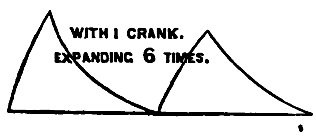


FIG. 2.

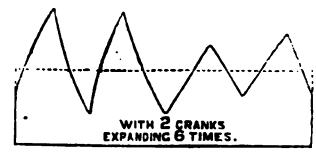


FIG. 3.

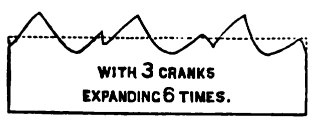


FIG. 4.

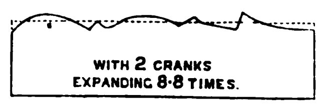


Fig. 1 shows the diagram of rotative power which is produced by using steam cut off at a quarter-stroke in one cylinder, the variation being from 100 to 0. To obtain good indicator figures, an expansion valve is required.

Fig. 2 shows that produced by using steam cut off at a quarter-stroke in two cylinders, the cranks being at 90°, and the variation being from 100 to 35. To obtain good indicator figures, two expansion valves are required.

Fig 3 shows that produced by using steam in three cylinders cut off at a quarter-stroke in each, the cranks of *the 3-throw crank shaft* being placed at 120°. The variation is from 100 to 70. To obtain good indicator figures, three expansion valves are required.

Fig 4 shows the figure produced by using steam cut off at nearly half-stroke in each of two cylinders in the above described uniform power expansion engine, the cranks being at 90° as usual, and the variation being from 100 to 77¼. No *expansion valves* are required to produce good indicator figures on this plan.

I may mention, if you do not require quite so much expansion as the figures from the "Briton" show, the rotative power can be much more uniform, in fact you can reduce it to about 22¼ per cent. variation in rotative power, if the two cranks are put at right angles and the steam cut off at very nearly half-stroke. If we wish to get the greatest uniformity of power, that is the way to do it; and it is far more regular than three cranks placed at other positions; two cranks placed at right angles is very much better than three cranks placed at 120 degrees apart. At the same time it is very convenient if you cut off at half-stroke in a cylinder for driving a blast-engine where the power required at the commencement of the stroke is nothing. It is clear a high-pressure expansion figure, expanding very considerably in one cylinder, does not fit at all to the power required in the blast cylinder, because the power is reversed. When it has expanded down to a very low pressure in the steam cylinder there is scarcely any power at the end of the stroke to finish the stroke of the blast cylinder which requires full power. In pumping engines you require a little more power at the commencement of the stroke, and towards the end of the stroke you require a little less on account of the momentum of the water and all the parts. So that you can expand in one cylinder by cutting off at *half-stroke*, and do the same in the other, and make both figures very nicely fit the power required in the pump. Then you can obtain a large amount of expansion by having

two cylinders to do it, first a high pressure, and then a low pressure, you thus get a large amount of total expansion.

Mr. BRAMWELL, C.E., F.R.S.: I do not know that I can make observations of any use in this matter. Let me say, however, that I am very glad to hear the spirit in which this paper is written, that is to say, a spirit that leaves the question between simple and compound engines perfectly open, so that a man whether making a compound or a simple engine may still be within good engineering. I am very glad that Mr. Rennie, after all his experience, puts the compound engine no higher. It is very difficult to say to what the preference for the compound engine is due, but I will suggest two causes to which it may be attributable. The first advantage of the compound engines is that they practically inaugurated the working of high-pressure steam in marine engines, and the other is that they put it out of the power of the British workman to spoil the action of the machine in his charge. If you give him a single cylinder expansive engine the steam gets a little bit low, and he finds he can get more strokes by giving less expansion. This he does; but, like a man taking to dram-drinking, he incurs future harm to obtain immediate relief. When such a man has a compound engine he cannot do away with his expansion, and I really believe the great secret of the economy of compound engines arises from the fact that by their use it is no longer in the power of an ignorant man to do harm, to improperly work the machine entrusted to his charge.

I have, in vain, endeavoured to appreciate the great importance of the uniformity of tangential forces which has been treated of for such a purpose as driving a screw propeller. I quite admit when you are driving a cotton mill, and from 25 revolutions a minute of the engine, you have to get up your speed for the spindles of a mule to 7,000 a minute, it is most important that the uniformity of the rotation crank shaft should be as near perfection as possible. If it be not, any little undulation is magnified so much that you feel the ill-effects of it in your spinning; but in screw propulsion I cannot think it so important, and I will give instances to show that it cannot be.

We have screw vessels doing excellent duty, I won't say equal to the "Briton," but still excellent duty, with only a single engine—vessels of a large power with a compound engine it is true, but with the high-pressure cylinder over the low-pressure cylinder, both pistons attached to one rod and acting upon one crank. In these cases the difference of tangential force is from nothing at the end of the stroke to probably the greatest amount somewhere before the middle of the stroke is reached; therefore the variations must be greater than anything we have heard in the instance of the "Swinger" with its pair of single cylinder expansion-engines at right angles; but if there were an importance really belonging to uniformity of tangential force for propulsion, single engines ought to work most descreditably. But they do not do so in these large screw steamers, neither do they with paddle wheels. Our American friends with paddle engines have done for years past upon their rivers, things we have never been capable of doing, and uniformly those are single engines, and slow-going engines running only 14 or 15 revolutions a minute, and it is well known these give excellent results. Therefore I say I do not think there can, as a mere propelling agent, be that value in absolute uniformity which some persons, especially my friend Mr. Cowper, attribute to it, and which Mr. Rennie is quite inclined to attribute to it, because in its absence he cannot account for the difference of some three-tenths of a knot which was observed in the speeds of the two which he has instanced.

Supposing uniformity of tangential force be not of value for working a propelling agent, is it of value as regards the endurance of the engines themselves? I am inclined to think uniformity of strain in the engine itself might be of value, but there is no necessary connection between uniformity of the tangential force of a pair of engines and uniformity of strain on the parts of those engines; because, recollect those figures we have here are the aggregate of the results of the two engines when considered in relation to one crank path; but in each engine, considered alone, there is not that uniformity, but there is the variation between the pressure of the initial steam and that at which it leaves the cylinder, and therefore, the piston-rod, connecting-rod, and crank-pin, so far as regards the up-and-down motion, are all of them affected by the conduct of the steam in the high-pressure cylinder in the same way as they would be if the steam were not afterwards used in another cylinder.

Thus, you must not think that you are getting a uniformity of strain in each engine itself—that clearly is not so; therefore it seems to me, unless it can be established that there is a necessity upon propelling agents to run with that obsolute uniformity, you fail to show that there is any great good to be got out of it for the purposes of propulsion. But it certainly does require very many counterbalancing advantages to induce one to do this fact, an inherent defect, in compound engines, which is not appreciated by those who do not make engineering a profession. Most persons, not as engineers, who consider the compound engine, are in the habit of thinking the two cylinders give an aggregate cubical capacity for working effect. Suppose, for example, you have a 50-inch high-pressure cylinder, and 100-inch low pressure cylinder, they fancy you get an effect due to the combined area of these cylinders, or 12,500 circular inches, the area of the two pistons. But those who make engines know very well no more is got out of those two cylinders than would be obtained out of the 100-inch cylinder, only with the steam expanded to the same degree; and that, therefore, the 50-inch cylinder is so much absolute waste as regards producing power. I may be told practically you cannot obtain your power in the single cylinder, that it would not bear the expansion, and that no doubt is the reason why the compound engine is used, coupled with the other reason that the men cannot derange it.

Having said this much, which shows that, if Mr. Rennie will let me say so, I, like him, am in the most undetermined state about the question for ocean steamers; I may, however, say, this is quite certain, that I should not recommend a compound engine for a short channel voyage.

I was very much surprised to hear Mr. Rennie state, that a compound engine is lighter, per horse-power, than the single expansive. One gets into very large dimensions with the low-pressure cylinder, and although the strains are not so great per inch, there is a necessity for very heavy weights, and a case has come under my notice where the advantages expected from compound engines in a steamer, to cross St. George's Channel, have been frustrated, because they have put the boats down ten inches lower, owing to the increased weight of the machinery.

I wish to challenge that table of Mr. Rennie's in one particular. I think I have heard him say before where he got it from, and I want, having had something to do with one of the cases cited in it, to challenge it. Mr. Rennie puts high-pressure engines, per horse-power per hour, at 6 lbs. I think I am right in saying, you got that from the average performance of the engines at the trials of the Royal Agricultural Society.

Mr. Rennie: No, I got that from the returns of the Government high-pressure engines.

Mr. Bramwell: Take the case of a locomotive engine. You will get a horse-power out of those engines certainly for 3½ lbs. with 140 lbs. of steam on; and it is equally certain, when high-pressure engines, working 80 lbs. of steam only, are doing their best on trial, you can get them down to a little under 2¾ lbs. per gross indicated horse-power per hour.

I wish I could get somebody to trust me, and to risk a few thousand pounds. I should uncommonly like to see, instead of these enormous machines in the steamboat, something of the locomotive type put in, and geared up by frictional gearing with a piston running 800 feet a minute instead of three or four. When we recollect that we really have had high-pressure engines developing an indicated horse-power to every 56 lbs. weight, including the water in the boilers, the boiler, the propeller, the shaft of propeller; and when we recollect that compound marine engines are not made very much under 4 cwt.; when we recollect the weights are eight to one,—it does seem to me that the man would deserve well of his country who would risk a few thousand pounds. If he succeeded, he would be lauded; if he failed, he would no doubt be called a stupid fellow; but I wish some patriotic individual present to-night would be inclined to make the trial under my auspices.

Mr. Perkins: I think Mr. Bramwell is rather wrong in saying a compound engine ought to weigh 4 cwt. per horse-power; I think it ought to be done easily for two.

Mr. Bramwell: I do not say it ought; I only say what it does.

Mr. Perkins: I think it has been done for 2 cwt. I have done it for 2 cwt., so

that I do not think it ought to be taken as 4 cwt. I think there are a great many done as low as 3 cwt.

Mr. WRIGHT: Mr. Rennie, as a successful maker both of simple and of compound engines, is of course entitled to speak with authority on the subject. I think, however, he has rather understated the case in favour of the compound engine as regards vessels of commerce, and perhaps he has slightly overstated it as regards vessels of war. As regards vessels of commerce, there have been some very good examples lately both of the compound and direct expansion engine at equal pressures. The last one I heard of was in a large ship running between Liverpool and America. The engines were 500 horse-power nominal, probably working to 2,000 indicated horse-power. After working ten or twelve months, I believe the results have been so bad that the engines are to be compounded. They were fitted up in the very best possible way. First, some parts of the engine gave way, such as the air-pump rods, and at last the crank shaft gave way, and in running, the noise and knocking was so great that the passengers were kept in a constant state of alarm. I have also heard of some other cases where the results have been most unfavourable, and I may mention on the last two or three occasions the Admiralty, in calling for tenders for engines, requested engineers, at the same time, to send in designs and tenders for simple expansive engines for the same pressure as the compound engines were to work at. A large firm on the Clyde, who had made direct expansion engines, stated, that their experience of them was so bad that they could not undertake the responsibility of tendering for them. I think, therefore, though Mr. Bramwell is rather strong on the point as regards vessels of commerce, a compound engine must be considered the best engine to be used. As regards vessels of war, one of the strongest objections made to the compound engine is this, that if you want to reduce the pressure in your boilers considerably, you would have a much greater falling off in power in the compound than in direct expansion engines. This is no doubt true, but the objection is made on the assumption that, as a matter of course, commanding officers would, in going into action, reduce the boiler pressure very considerably, with the view of obviating disastrous results, if a fracture occurred in the boiler, steam pipes, or part of the engine, to allow the steam to escape. In armour-plated ships the machinery is well protected; in unarmoured vessels, in all cases, the engines and boilers are to a greater or less extent under the water-line, and I should rather think that commanding officers would be inclined to retain the full power of the engines and the full speed of the vessels rather than to sacrifice a considerable amount of speed by lowering the pressure. This, however, is a question which the naval members of this Institution will be best able to give an opinion upon.

There is another point which Mr. Rennie has not noticed. He quotes a table, showing the comparative consumption of the compound engines, and the ordinary type which immediately preceded it. I believe these results are very nearly correct, and if you take an average probably the compound engine is 30 per cent. more economical than the engines that immediately preceded it, such as those in the "Devastation" or the "Hercules." He has omitted one part in the calculation, and that is the weight of the compound engine as compared with the simple engine which immediately preceded it. We find from a great many examples the compound engine is from 10 to 15 per cent. heavier than the simple engine. In vessels of war, the weights that can be carried are limited; in fact, it is a very great struggle constantly with regard to weights. In considering the best engines for a vessel of war you must take the aggregate weight of engines and coal; but if you take 10 or 15 per cent. as the difference between the compound and the ordinary engine, you must take an equivalent amount from the coal-storage, and, taking about an average of the quantity of coal carried in vessels of war, it will reduce the time which a vessel can keep the sea, or the distance she can run, to something about 20 per cent. in favour of the compound engine, instead of 30 per cent.

As regards the future, I may mention that instead of going to large examples of direct expansion engines, the Admiralty have commenced rather at the lower end with the engines of the "Swinger," 360 initial horse-power, and may probably gradually work upwards. At the present time, two sets of engines have been ordered, direct expansion, to work up to an indicated horse-power of 900. There are a

number of engines in similar vessels of the compound type, and one set also has been ordered on Mr. Perkins' plan for vessels of the same type, and I hope that if time will permit, we shall be able to get some very good trials to show the relative merits of these three kinds of engines.

With regard to the policy of having so many compound engines for the Navy, I may mention that the large committee on designs of ships appointed by the Admiralty two or three years ago, very strongly recommended the general adoption of compound engines for vessels of war. I also saw, a few days ago, a report from America showing that the American Government had appointed a committee of officers to report on a number of engines in store at the several dockyards, and the conclusions the officers came to, were to recommend the general conversion of these engines into compound engines and to appropriate them as opportunities occur to vessels of war: I think there were something like 16 or 18 engines altogether.

So far, therefore, as we can see at the present time, I think the compound engine, both for vessels of commerce and vessels of war, is the best type of engine we can adopt. We are gradually feeling our way to higher pressures, and if Mr. Perkins' engine turns out satisfactorily, as I hope it will, we shall make a very great step in advance, as regards pressure, of what we have yet done. We have had a great many difficulties in getting to the pressures we have arrived at, which perhaps the public out of doors, when they hear of mishaps occurring, do not make quite sufficient allowance for, but I hope as we gain experience, we shall be able to overcome those difficulties.

The CHAIRMAN: What is the high pressure?

Mr. WRIGHT: About 250 lbs. I presume. If he likes to go higher, say to 500 lbs., I do not suppose anybody will object.

Mr. BRAMWELL: I should like to ask Mr. Rennie whether in calculating those diagrams of tangential force any allowance has been made for the arresting momentum of the weight of the part at the termination of the stroke and the re-starting of the parts, or whether the parts have been taken as imponderable?

Mr. RENNIE: No allowance has been made: they are taken at the actual pressures of the piston.

Mr. BRAMWELL: If the weight of the part be taken into account it would very materially modify the tangential force.

Mr. COWPER: One word in explanation, in reference to the observations of Mr. Bramwell. I may mention that I did many years ago try all I could to expand eleven times in each cylinder of a pair, but the irregularity of motion was such, that it was an impracticable and an unengineering job. That was with one pair of engines under my own charge, and I did think I was going to prove I was right in expanding in one cylinder, but I convinced myself I was wrong, and I am glad to find Mr. Wright coincides with me in the practical conclusions arrived at. The uniformity is greater, the steadiness of the ship better,—most markedly so. It happened in the "Briton," we had exactly the same screw as another ship where the vibration was at least half as much again. I think there cannot be a shadow of doubt but that the uniformity of rotative power produced a uniformity of motion in the ship, and less strain.

Capt. SELWYN, R.N.: I think there are one or two points on which naval men may have something to say. I have always believed and said that there was much more in the daring to carry higher pressures in the boiler than in any particular form of engine adopted for the utilisation of those pressures, but still, having made some six voyages lately across the Atlantic in the largest Atlantic steamers, fitted with compound engines, I am bound to say, the compound engines have very great advantages, among which are certainly not uniformity of motion, because our engineering friends will do well to consider that one of the great evils at sea is the absolute impossibility of getting any uniformity of motion whatever. That which we have most to contend with, is the racing of engines, and until you can remedy that, it is utterly vain to give us a uniformity in smooth water, though it will be, no doubt, of the utmost value in a cotton mill where, as Mr. Bramwell says, the least undulation produces injurious results throughout the whole machinery. For the sea, efforts should be directed to the attainment of some controlling power over

the engines, when the screw is pitched clean out of water. Secondly, I should desire to answer Mr. Wright by saying that the Naval Officer, in my opinion, who ever has an idea of lowering his steam when he goes into action to evade any danger from that steam, is much more likely to incur the danger of having his whole ship sunk by a ram, or entirely put out of action by some other casualty of that kind. He had much better consider that he saves his steam as much as possible during the time he goes about the world in order to use it at its very highest power and pressure, no matter what may be the danger, when he does come into action. He might just as wisely drown half his magazine on going into action to avoid risk of being blown up, as lower half his steam to avoid being scalded by injury to his boiler. Existing forms of boiler are radically bad where high pressure is to be carried and will lead to disaster if not remodelled in accordance with the proper laws of strength and disposition of material: *tubulous* [1] boilers will not only afford an improvement in this direction, but also allow of repairs being effected without cutting the ship to pieces every time new boilers are required.

Mr. RENNIE: I do not know that I have very much to answer. It seems to me that the example Mr. Wright gave of the simple engine of that Atlantic vessel, and what Mr. Cowper mentioned, have pretty well answered Mr. Bramwell; and I should think if Mr. Bramwell made a very large single engine, he would come to the conclusion not to make another on that plan. What he says about the uniformity of motion in the American steamers is very true. Every one connected with engineering knows that the Americans have, as a rule, adopted the large single cylinder for propelling their vessels, and these vessels have very great speed, but we do not know whether if they used an engine with more uniform motion at the same power, they would not get a greater speed. I am inclined to think they would. I was glad to hear what Mr. Wright said about the weight. Mr. Wright said the engine being 10 per cent. heavier, taking the coal at 30 per cent. less, it practically reduces the advantage you get with compound engines to 20 per cent. But 20 per cent. is a very considerable amount; that is to say, you may steam six days instead of five days with the same amount of weight of engine and coal.

Mr. Cowper mentioned our having adopted his reservoir in the engines of the "Briton." I did not mention that in my paper, simply for this reason, that I sent Mr. Cowper an invitation to come here, and I thought he would explain it himself. As far as I have seen, that large reservoir had the advantage of keeping up an equal power in the two cylinders. That there was much advantage in the steam jacketing of that cylinder we were not so certain of, for in the "Thetis," a similar vessel, we first tried the engines with the reservoir; the reservoir was then entirely disconnected and we tried it with merely a connecting pipe between the two cylinders. The result was no material difference in the consumption of coal, but there was an advantage in having a greater uniformity of the power between the two cylinders.

Mr. Bramwell questioned my figure of six pounds per indicated horse-power for the high pressure engine, and he mentioned that some of the agricultural engines consumed as low as 2¾ lbs. per indicated horse-power. [Mr. BRAMWELL: When on trial.] Those trials are so exceedingly deceptive, and if you go to a maker and ask him to make you a similar engine to that which was tried at 2¾ lbs., and to guarantee you even 3 or 4 lbs. or 5 or 6 lbs., he will hardly do it.

Mr. BRAMWELL: Four, he would certainly, and if you wanted 3 they would have to provide you the engine-driver with the engine.

Mr. RENNIE: I am told even more. We have got a very good engine of that sort and we never get as far as we can make out anything like even 6 lbs., and I thought putting at 6 lbs. was within the mark.

Mr. BRAMWELL: I have a large locomotive practice to substantiate my tables,—engines in daily work on thousands of miles of railway.

Mr. RENNIE: At all events I put that figure down as regards the high pressure engines as used on board ships.

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[1] *Tubulous*, not tubular. Tubulous boilers are those in which the water is contained in tubes and the fire circulates round them as distinguished from tubular, in which the fire passes through tubes surrounded by water.

The CHAIRMAN: I am sure I am only expressing the wish of the meeting in thanking Mr. Rennie for the paper he has brought before us. Our thanks are also due to those gentlemen who have taken part in the discussion. There has been a good deal of practical information given to us by the various gentlemen who have addressed the meeting.

DELINEATIONS OF SOME MINUTE SEA-SURFACE ANIMALS.—From Coloured Drawings by Mrs. TOYNBEE.

"The works of the Lord are great, sought out of all them that have pleasure therein."

THE accompanying delineations of a number of minute natives of the ocean surface, as seen through a microscope, have been selected from a large number of coloured drawings[1] made during sea voyages by Mrs. Toynbee, who, at the request of Rear-Admiral Nolloth, permitted him to offer them to the Council for publication in the Journal. It is hoped that young Officers may be induced (like Navigating Lieutenant Palmer, who brought home most interesting sketches of the kind made on his way from China) to spend some portion of their leisure time at sea in procuring similar collections, the pleasure of the pursuit being enhanced by the prospect of adding to our scanty knowledge of this region of nature.

The means required are very simple and inexpensive:

A sufficiently powerful microscope can be bought for less than one pound.

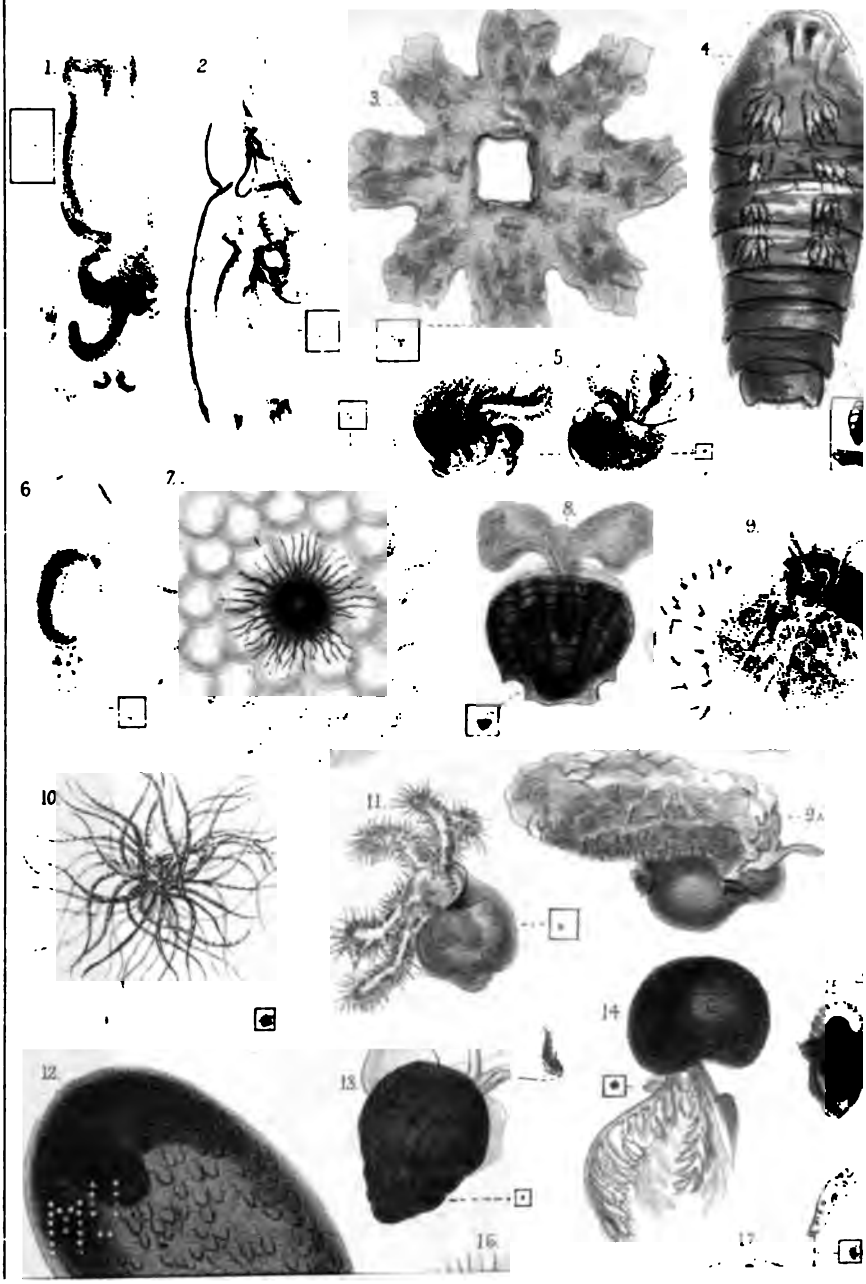
A twine bag-net lined with white bunting should be towed day and night in calms when not under steam, and during daylight when the ship is at very slow speed: it may be hauled in at intervals of about a quarter of an hour, and washed in salt water, in a bucket painted white, with a black streak at the bottom, for the sake of greater conspicuousness of objects.

Specimens can be readily taken up for inspection and delineation under the microscope by means of a glass tube, one end of it being closed by the forefinger, and the other placed over the object in the bucket. On the finger being removed the individual is drawn into the tube, and easily dropped on to a piece of glass for examination.

The latitude and longitude, the temperature of the sea-surface, the current during the last 24 hours, the habits of the creatures—their modes of locomotion and of disporting themselves, &c., some of which are very interesting—should be noted.

If preservation of any remarkable specimens should be desired, the

[1] Eight plates will be issued with descriptive letter-press.—*Ed.*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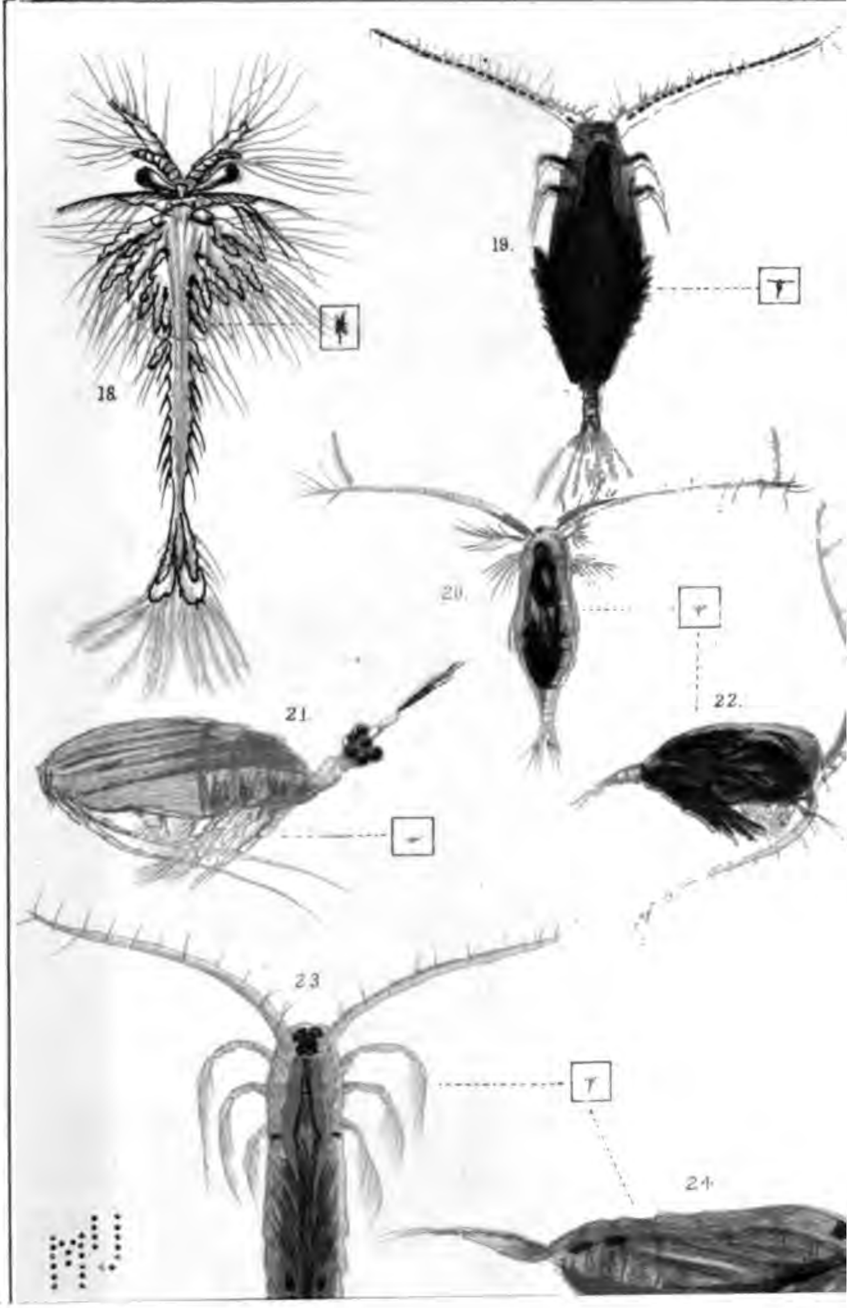
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little bottles of a homœopathic medicine-chest will be found useful,—the bottles containing spirits of wine, with one-third fresh water.

The names which precede the remarks on some of the figures have been pencilled on the original drawings by various Naturalists who have looked through them.

PLATE I.

Fig. 1. March 27th, 1858. Lat., 0.04 N.; long., 82.24 E. Current in two days, N. 61 W., 57 miles. Found this delicate Diphya? in active motion, the lilac proboscis expanded and contracted.

„ 2. *Diphydæ. Eudoxia? one of the Hydrozoa.*—May 20th, 1857. Lat., 30.00 N.; long., 45.13 W. Current, N. 78, W. 2 miles. Temperature of surface water, 71.1°. This specimen was found in the bucket drawn to ascertain the temperature. It was very active; motive power seemed to be in its lowest part, as the upper part was always kept foremost.

„ 3. *Young Medusa.*—May 27th, 1857. Lat., 31.02½ N.; long., 45.06 W. Current, S. 14 W., 2 miles. Temperature of surface water, 73.3°. It was in constant motion, contracting and expanding its rays.

„ 4. *Crustacea. Copepodæ. Sapphirina coruscans.*—May 9th, 1857. Lat., 3.49 N.; long., 28.02 W. Current, N. 50 W., 30 miles. Temperature of surface water, 79°. Caught in the net; it was transparent, but as it turned in the water, it shone with the brightest prismatic colours. It was very active, and each time it turned the colours changed.

„ 5. June 8th, 1858. Lat., 18.26 S.; long., 5.17 W. Current, N. 7 W., 6 miles. Temperature of surface water, 71.5°. Specific gravity, 1027.5. These shells were extremely abundant, the net being towed at night during a calm.

„ 6. Oct. 5th, 1857. Lat., 12.06 N.; long., 26.49 W. Current, N. 49 W., 28 miles. Temperature of surface water, 80°. The transparent part looked glassy, the yellow, soft; below the yellow were bubbles in constant motion.

„ 7. *Thalassicolla.*—May 9th, 1857. Lat., 3.49 N.; long., 28.02 W. Current, N. 50 W., 30 miles. Temperature of surface water, 79°. This remarkable formation had apparently no motion.

„ 8. Feb. 4th, 1858. Lat., 17.11 N.; long., 83.24 E. Current, N. 64 E., 15 miles. Found several of these bivalve Pteropods? moving actively by means of their wings.

„ 9. and 9*a*. *Ianthina.*—Dec. 1st, 1857. Lat., 34.34½ S.; long., 77.26½ E. Current, N. 44 E., 17 miles. Temperature of surface water, 67°. Found many shells of *Ianthina communis*, some without swimming floats were attached to the lower surface of Velellas? In nearly all cases, they were accompanied by a small crab of the same colour as themselves.

„ 9. Looking down on it; 9*a*, side view.

„ 10. March 23rd, 1857. Lat., 26.53 S.; long., 58.14 E. Current in four days, N. 22 E., 41 miles. Temperature of surface water, 76°. Found this star without any apparent motion.

„ 11. *Macgillirrayia or Cheletropis.*—July 8th, 1858. Lat., 29.39 N.; long., 42.14 W. Current, S. 18 W., 9 miles. Temperature of surface water, 77°.

„ 12. Nov. 24th, 1857. Lat., 39.59 S.; long., 63.10 E. Current, N. 70 E., 21½ miles. Temperature of surface water, 58°. The purple protuberance of this object seemed, occasionally, to contract.

„ 13. Dec. 17th, 1857. Lat., 8.12½ S.; long., 81.24 E. Current, S. 74 W., 39 miles. Temperature of surface water, 81°. This shell was opaque, but its inhabitant was clearly seen.

„ 14. July 8th, 1858. Lat., 29.39 N.; long., 42.14 W. Current, S. 18 W., 9

miles. Temperature of surface water, 77°. This shell was caught in the net, though generally seen attached to the gulf weed. The tendrils were shot out suddenly at intervals, and worked rapidly while exposed.

Fig. 15. *Mesatrochous larva of Annelid.*—April 9th, 1858. Lat., 12.48 S.; long., 74.30 E. Current, N. 24 W., 17 miles. Temperature of surface water, 81.2°. It was very active, darting about in the water, its ciliæ in rapid motion.

„ 16. *Thalassicolla.*—Jan. 2nd. Lat., 11.17 N.; long., 81.45 E. Temperature of surface water, 78.3°. This appeared like a ball of transparent jelly, opaque in the centre, contained in a net of fibres, from which spikes protruded. No apparent motion.

„ 17. *Probably allied to Planaria.*—May 9th, 1857. Lat., 3.49 N.; long., 28.02 W. Current, N. 50 W., 30 miles. Temperature of surface water, 79°. Many were found in the net. It appeared to be a circular disc, with globular centre; it moved by working the edges of the disc.

PLATE II.

„ 18. *Larval Crustacean.*—May 22nd, 1857. Lat. 31.02¼ N.; long., 45.06 W. Current, S. 14 W., 2 miles. Temperature of surface water, 73.3°. It worked its long front legs actively.

„ 19. *Cyclops.*—Nov. 25th, 1856. Lat., 10.14 S.; long., 79.58 E. Temperature of surface water, 79.1°. Pumped up this crustacean. The hairs of the tail were like feathers, and very beautiful; it had the power of expanding and contracting them.

„ 20 and 22. Nov. 28th, 1856. Lat., 3.25 S.; long., 82.30 E. Temperature of surface water, 79.8°. This is an example of the many variously and brilliantly coloured crustaceæ found in this position; their colours changed after being some time under the microscope, several of them ejected the colouring matter, which was probably their food. Fig. 22 is a side view of the crustacean represented in Fig. 20.

„ 21. March 5th, 1857. Lat., 0.11 N.; long., 82.41 E. Temperature of surface water, 85°. Found this small blue crustacean, which had a few eggs on its tail, April 25th, 1857; lat., 19.25 S.; long., 0.59 W. Temperature of surface water, 70°. The bucket was alive with these crustaceæ, many of them with large bunches of eggs on their tails.

„ 23 and 24. *Crustacea. Copepoda.* Nov. 28th, 1856. Lat., 3.25 S.; long., 82.32 E. Temperature of surface water, 80°. This crustacean kept up a circulation in the water by working its feet and tail.

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OF THE
Royal United Service Institution.

VOL. XIX. | 1875. | No. LXXXI.

Evening Meeting.

Monday, February 15, 1875.
CAPTAIN THE RIGHT HON. LORD GILFORD, R.N., Lord of the Admiralty, in the Chair.

NAMES of MEMBERS who joined the Institution between the 2nd and 15th February, 1875.

LIFE.

Wing, H. Tryon, Lieut., 97th Regiment.
Watkin, H. S. Spiller, Lieut., R.A.

ANNUAL.

Seccombe, John W., Captain R.N.
Gunter, Edwd., Captain 69th Regiment.
Flood, J. C. H., Lieut., 19th Hussars.
Laughton, J. K., Esq., M.A., R.N., Naval Instructor, Royal Naval College, Greenwich.
Sloggett, W. H., Dep. Inspector General of Hospitals and Fleets.
Burroughs, F. W., C.B., M.-Gen., Unattd.
Lloyd, Arthur C., Lieut. 45th Regiment.
Owen, F. H. E., Capt. R.M. Artillery.
Browne, E. C., Captain 21st R. N. B. Fusiliers.
Greenaway, H. C., Captain 10th Bengal Lancers.
Clarke, Stanley de A. C., Major 4th Hussars.
Young, J. S., Dep. Commissary.

SCIENTIFIC INSTRUCTION IN THE NAVY.

By J. K. LAUGHTON, Esq., R.N., M.A., Mathematical and Naval Instructor at the Royal Naval College.

IN accordance with the wish of your Council, I have undertaken to give you some account of the work which is being done in the Royal Naval College, and its general bearing on the scientific instruction of our Naval Officers. I am glad to have the opportunity of doing this, for though a great deal has been publicly said and written about "the higher education of Naval Officers," it is quite evident that a large

proportion of this has been said and written by persons who have very vague idea of what is properly meant by the phrase, "highe education of Naval Officers," who entirely misunderstand the objects o the College, and who are utterly ignorant of the way in which we—th staff of instructors at Greenwich—are endeavouring to carry ou those objects.

In establishing the Royal Naval College at Greenwich on its presen footing, it was undoubtedly the wish and intention of the Admiralt to give the Officers of the various branches of our service increase facilities for studying certain subjects, the knowledge of which mus make them more capable, and therefore more efficient.

The Admiralty Circular, dated the 30th January, 1873, announcin the establishment of the Royal Naval College at Greenwich, is reprinte in the "Navy List," and most of you are probably familiar with it. will, however, recall to you that that Circular declares the College t be opened for—

1. Captains and Commanders.
2. Lieutenants.
3. Navigating Officers.
4. Naval Instructors.
5. Acting Sub-Lieutenants and acting Navigating Sub-Lieutenants
6. Officers of the Royal Marine Artillery and of the Royal Marin Light Infantry.
7. Officers of the engineer branch of the Service, viz.:—
   Chief Engineers.
   Engineers.
   1st class Assistant Engineers.
   Acting 2nd class Assistant Engineers.
8. A limited number of dockyard apprentices, annually selected b competitive examination.
9. Private students of naval architecture or marine engineering.
10. Officers of the Mercantile Marine.

Of these 10 classes the students at the College are composed, an with reference to the course of studies pursued, are divided thus:—

Classes—

7, 8, 9 } form Division A.

1, 2, 3, 4[1], 6, 10 } form Division B.

5 forms a Division by itself.

[1] No Officers of this class have yet joined.

You will understand, then, that Division B includes all executive and navigating Officers above the rank of Sub-Lieutenant, Officers of the marine artillery and light infantry, and Officers of the mercantile marine. At the present time it consists of the following:—

Captains	3
Commanders	4
Lieutenants	65
Navigating Lieutenants	8
Captain R.M.A.	1
Lieutenants R.M.L.I.	2
Lieutenants of Royal Marines qualifying for the Artillery	6
Probationary Lieutenants of Marines	9
Master in the Mercantile Marine	1
Giving a total of	99

Considered from a naval point of view, this division is the most important. Material as the age is, we cannot forget that it is to our sailors, Officers and men, that we owe our past maritime greatness; and that it is to them, not to our engineers and naval architects, that we primarily trust for the future. I am taking the subject, then, strictly in the natural order, although in defiance of the conventional arrangement of the letters of the alphabet, and am going in the first place to speak exclusively of the studies of division B, and of the division of Sub-Lieutenants.

The scientific instruction of executive Officers is a point that has been widely and wildly discussed. It has been, and still is often maintained, that the Navy is a purely practical service; that a Naval Officer should be a purely practical man; and that any intermixture of theoretical knowledge must be injurious to him. It has been maintained that our old heroes would have scouted the idea of a Naval Officer having any tinge of literature or science. I have heard—is there any one here who has not heard—it said, "What would old Benbow have said to such a thing?" as if, forsooth, a runaway butcher's apprentice is to be accepted as the ideal Naval Officer of the olden time; or as if the speakers had forgotten—perhaps I should say had never known—that, years before Benbow was born, Drake had shown that a man might be a skilful engineer as well as a bold seaman; Raleigh had shown how to write, as well as to act, history; and Grenville had shown that a courteous gentleman and finished scholar could fight like a Paladin, and die like a hero.

I am not here this evening to dwell on the teachings of our old history: I have alluded to them only because this oft-repeated Benbow argument seemed to call for it, by claiming a traditional acceptance of the overpowering value of mere practical seamanship. I am as ready as any one to acknowledge the vast importance of this practical seamanship; to insist that without it everything else which a Naval Officer may learn is worthless; to admit that it is to it, and in a great measure

to it alone, that our past glories are due; but I would none the less insist that our naval history would be still more brilliant had the necessity of combining scientific instruction with practical experience been more early recognised; and I would point distinctly to the fact that several of the deeds of former days, the memory of which the service loves to recall, are to be especially attributed to the then rare combination of theoretical knowledge and practical skill. It was no mere practical seamanship that annihilated the French fleet at the Nile; it was no mere practical seamanship that piloted the "Resolution" round the world and through unknown seas, without losing a man by scurvy, and that in an age when such ships as the "Centurion" commanded by thorough seamen, were simply pest-houses; or to speak of later days, it was no mere practical seamanship that got the "Gorgon" off that storm-lashed beach of sand and mud in the Bay of Monte Video. No! not mere practical seamanship, but practical seamanship, supplemented by a careful study and sound knowledge of tactics, navigation, hygiène, and mechanics.

I wish, then, at the outset, to declare war against the proposition that theoretical knowledge and practical skill are opposed to each other; a proposition that is often put forward, and more frequently, perhaps, by implication than in plain words. And it is not with practical men alone that the fault lies; vain and unscientific theory is an abomination of the age, and makes us sometimes think that the Island of Laputa has settled down on the western outskirts of Europe, and that the day may come when we are to be measured for our clothes by theodolite and tables of logarithms. But the model practical man, without being, perhaps, so utterly absurd, is a very helpless creature. He does as he has been told, and beyond that has not an idea. Faith, in matters religious, may be an excellent quality; but in matters scientific, it is the emblem of stupidity and ignorance, an enemy to knowledge, and a barrier to advancement.

Scientific study implies incredulity, an unwillingness to believe; and whatever the question studied may be, a man has not really mastered it until that incredulity, that unwillingness, has been fairly overcome by complete and exact investigation. It is thus that the attainable end, in so many branches of science, is merely doubt; it is thus that the rational acknowledgment of ignorance and incompetence is frequently the bound of human inquiry. This feeling of helplessness will scarcely, however, occur within the limits of what may properly be called naval education. In that, at least, we have well defined paths before us, paths which it is the duty of the instructor to point out, as a guide only, not as a conveyance; it is no part of an instructor's duty to carry the student over all difficulties, and set him down at the far end, without the faintest idea how he got there, or how the obstacles have been overcome.

Between the old system of leaving the student to find everthing out for himself, and the new system which would give him nothing to find out, a mean, widely distant from either, must be struck; the aim of all teaching is not merely to impart a certain amount of knowledge, which must, from the necessary limit of time, be itself limited; it is rather

to cultivate a power of acquiring knowledge, a habit of disciplined thought, the results of which extend far beyond the bounds of any collegiate or university session—even to the utmost period of our lives.

This, then, is the principle on which scientific instruction must be based; and so-called instruction on any other basis, is not instruction, but *cram*. I am not going to detain you now with a discussion of the abominations of any system of cramming. I will not say it is unknown at the Royal Naval College, for wherever there are examinations, compulsory examinations especially, the many-headed monster will force himself in; but we do endeavour to keep the creature down; to devote ourselves to the work of instruction, accepting examinations as a necessary evil.

Having thus defined what we mean by instruction, I would ask your attention whilst we discuss the subjects in which instruction has to be given. Now these subjects must be as means to some end; they must be of such a nature as to assist the learner in attaining the desired end; but with the end itself, the instructor has, as a rule, nothing whatever to do. The carrying out that end is the afterwork of the instructed. I do not here speak of the direct technical and practical instruction which is given, not as mere instruction, but by compelling the learner to assist, subordinately, in the performance of some duty. Whatever is learned in this way alone, is learned without understanding, and the understanding, if ever got at all, must be got by some other means. It is these means, then, which form the subjects of that instruction of which I have now to speak. In our case, as in all others where the instruction is to be considered as a means to some well defined end, the choice of subjects is necessarily limited to those which relate to the end proposed; and in making that choice, the end must of course be kept very distinctly in view. But when the choice is once made, when the subjects are once determined on, the end which has guided that choice and ruled that determination may be for a while lost sight of; the intermediate course of instruction aims not at the original object, but at securing a sound and intelligent knowledge of the one particular subject.

It is therefore to this choice of the subjects which are now studied at the Royal Naval College that the principal interest belongs; and it is this choice which determines, not only in its broad outline, but in its minutest details, the character of the present more enlarged effort to establish the theoretical instruction of our Naval Officers on a scientific basis.

First of all then is the study of mathematics. There is no use attempting to shirk the many and difficult questions which arise on this point. It is argued that the study of mathematics is one, in itself, so engrossing, that no one who does not give to it much more time than a Naval Officer has at his disposal, can possibly make any real progress in it: that the devoting an important year to it is as if a man going to build a house were to spend all his money in setting up the scaffolding: that Officers, when they come to the College, are past the age when the study of mathematics can be advantageously commenced:

that if a man has attained mature years and high service rank he has no disposition to plod, for the first time in his life, through the elements of Euclid or algebra: that the idea of making Naval Officers a body of skilled mathematicians is both vain and useless: and in fine, that the time might be much better employed.

Now these and such like arguments must be considered, for they have been put forward by men whose opinions have, and deservedly have, very great weight; but it seems to me that they have been urged in some cases hastily, in others incorrectly, in others even ignorantly. I do not, for instance, suppose that it ever, for one moment, entered the heads of those on whom the organization of the College devolved that all Naval Officers should become skilled mathematicians; but certainly if they ever did entertain such a wild idea, a very short experience must have been sufficient to dispel it. None the less, they have decided, and I think decided rightly, that, so far as possible, a certain amount of mathematics should be read by every Officer who joins the College. It is not therefore necessary to suppose that they have acted in ignorance of the impossibility of men advancing, in the course of a few months, beyond the very threshold.

But, you will perhaps say, that is the very point of the argument: if men cannot possibly, in the time, attain a competent knowledge of mathematics, what is the use of a mere smattering? Well, then, we do not aim at a mere smattering. Our wish is that the mathematical knowledge acquired should be sound, so far as it goes, however short the distance may be. To what use then? Certainly not to apply it in independent investigations; barely perhaps to enable the student, in after years, to follow the meaning of the more abstract treatises which relate to the subjects he is interested in.

There are, however, certain most important branches of naval science, such as navigation, nautical astronomy, and surveying, in which nothing, absolutely nothing, can be done without some knowledge of mathematics; and whoever studies these subjects on any non-mathematical basis does so, not scientifically, but empirically, or, as it is more commonly called, by rule of thumb. But the amount of mathematical knowledge absolutely required for this is small. Most of the important problems in surveying are based on the Third Book of Euclid, and nautical astronomy demands no more than an acquaintance with the leading propositions in spherical trigonometry; so that really a great deal of practical knowledge can be established on a scientific basis with this very small amount of mathematics.

I do not, however, think that even the advance towards these subjects, valuable as it is, is the most important result of our mathematical study, or is the object more especially in view in prescribing it. I think rather the object is to cultivate that power of concentrating the mind, which to very few is a gift of nature, but which the study of mathematics, more markedly than any other study, may develop or enlarge. Pray do not go off with the idea that I, as a mathematical instructor, am merely saying this on the principle that "there is "nothing like leather." I would not be understood as saying that an advanced knowledge of mathematics is a necessary part of a liberal

education; but I do say that, for cultivating an exact and accurate tone of thought, a certain amount of mathematical training is indispensable.

I am here speaking, you will observe, of the advantages of mathematical study on the lowest and most general grounds; advantages which it offers to every one who will honestly apply himself to it. There are, of course, some who are not disposed to do so, whose minds have hardened down into other grooves, and whose age and standing in the Service are considered as giving them both a capability and a right to judge for themselves.

The rule, then, of devoting a considerable portion of the time to mathematical studies, which has been made absolute for junior Officers and for Lieutenants, has been left optional for Commanders and Captains; these are indeed advised to follow the general course, but if that is positively distasteful to them, they are at liberty to occupy themselves with more practical studies.

On the other hand, there are more than a few who, having a natural aptitude for mathematics, and having previously passed through the elementary drudgery, can and do attain a very respectable proficiency, and carry away with them a knowledge, and a trained power of acquiring knowledge, which may afterwards lead to very valuable results.

The recent alterations in the scheme for the examination of Sub-Lieutenants, which will enforce on all, as midshipmen, a greater degree of attention to the mathematical subjects than has hitherto been common, will necessarily, in future years, do away with a certain portion of the elementary work which has now to be gone through at the College; will give our students a better start, enabling them in fact to begin at the point where most of them now end. This is a consideration which we cannot and do not lose sight of, and which renders us hopeful that, before very long, the numbers of the more advanced minority will be considerably increased, and that the very irksome work of those who will always, in the nature of things, form the majority, will be considerably alleviated.

Still more hopeful shall we be if the Admiralty shall ever see fit to make a very decided change, either in the age for the entry of naval cadets, or in the system at present pursued on board the "Britannia."

The objections to increasing the age of entry are manifold; and though from a purely theoretical point of view, I would be inclined to wish that they could be overcome, the weight of authority and antecedent opposed to such a change is almost overwhelming; at any rate, I think very decidedly that it would be worse than rash to ignore all past experience, all history, until it has been more clearly shown than it has been, up to the present time, that the change is necessary. The report of the Naval Cadets' Committee recently issued, recommends, rather, a sweeping change in the system followed out on board the "Britannia." I wish for a moment to call your attention to some of these recommendations.

"We are of opinion," say the Committee, "that the brains of the "cadets are overtaxed, not by the amount of time devoted to study,

" but by the excessive number of subjects and the system of 'cramming' " and over-examination thereby necessitated.

" We are of opinion that the number of subjects studied is too great " to allow of any being thoroughly mastered, and that the knowledge " acquired, especially in the English subjects, viz., history, scripture- " history, geography, grammar, and literature is of the kind which " taxes the memory rather than the reason.

" The course of mathematical study, though far more thorough than " that in English subjects, appears to us to fall short in like manner of " the position it ought to attain, both as a means of mental training " and as a grounding in mathematical knowledge. Both the habit of " accurate reasoning and the possession for practical purposes of con- " siderable scientific attainments are so important to Naval Officers, that " it is most desirable they should receive, when young, a thorough " grounding in those subjects, without which a knowledge of the " higher mathematics cannot afterwards be acquired."

With these principles I heartily agree. Except in rare instances and under peculiar circumstances, if a good foundation of mathematical knowledge is not laid before a boy is sixteen, it will never be laid at all; and if the Admiralty really desires to increase largely the number of capable mathematicians amongst the Officers of the Service, or to work up the few to a higher standard, the change must be made at the beginning, it cannot be thrust in at the end. I again quote from this report.

" As a consequence of the imperfect grounding received by many " cadets, even in the more important subjects, much that is learnt on " board the 'Britannia' is speedily forgotten, and has to be re-acquired " under the Naval Instructor of the sea-going ship to which the cadet is " appointed. The midshipman, instead of learning seamanship and the " duties of an Officer, and having a reasonable amount of leisure, has " to devote his time to elementary studies which ought to have been " firmly fixed in his mind years before, and too often acquires a dislike " for a profession which appears to him rather that of a school-boy than " of an Officer.

" We cannot consider any system of training successful which does " not relieve the midshipman from the necessity of devoting his main " thoughts and time to mere school duties."

The Committee is thus led to recommend that, amongst other important changes, the course of training should he extended to three years, that the "cram" subjects already spoken of should be done away with, and that the mathematical subjects should be taught in a more thorough manner than is now possible. Boys entering between the ages of twelve and thirteen would therefore pass out into sea-going ships between the ages of fifteen and sixteen, having a good groundwork of elementary mathematics, and able to devote themselves almost exclusively to their duties as Officers and young sailors.

That the Committee should have expressed an opinion so thorough-going and outspoken as this, is in itself a great triumph for those who have for years past protested against the course of cramming which has been carried out on board the "Britannia." I believe that the

opinion so expressed will find an echo in the heart of every Naval Instructor in the Service, and that the proposed scheme will commend itself as striking at the very root of the evil. I do not know that the Admiralty have as yet determined to follow out these proposals; if they should do so, and if they should be fortunate enough to secure as Chief Instructor a man such as the Committee speak of, a man of ability and energy and experience, the results in favour of sound education will be incalculable.

I have already said that to Commanders and Captains, the mathematical course at the College is quite optional; as a matter of fact, those whose inclinations do not lead them to it, avoid it. But for all ranks of voluntary students the time devoted to mathematical study has been very much overstated by common report, a report which I would wish to correct, as it may possibly tend to prevent Officers, senior Officers more especially, from joining as readily as they otherwise would. In reference to this I would quote an article in the last number of "Naval Science":—

"To submit Officers of rank of the mature age of thirty years and "upwards to one procrustean course of elementary mathematics, to the "acquisition of which their previous career has quite unfitted them, "which must necessarily consume the most valuable portion of their "nine months' residence, seems to us a height of absurdity for which "even our present illogical system had hardly prepared us."

With all this I quite agree; it would be a height of absurdity; but I do not know that such a height has yet been reached anywhere; certainly it has not been reached at the Royal Naval College.

Evidently the information on which the writer of this article has based his statement has been imperfect and incorrect; and it is necessary to call attention to this, because as the article has been published under the auspices of the late Director of Education, it has been considered as embodying his views, and as based on his official knowledge.

Now, it is a very old proverb that there is no smoke without fire, and as this report, which the writer of this article in Naval Science has adopted, has been generally spread abroad, has been very generally believed, and has, to some extent at least, proved injurious, I think it will be well for me, having this opportunity, to trace out the fire which caused this smoke; show you that it was a very harmless fire after all, and that a bucketful of water thrown over it has long since extinguished it. To do this, it will be necessary to speak of the early days of the College.

It is exactly two years since the College was first opened for the reception of a few Gunnery Lieutenants, who were finishing or going through the old course, as it had been long prescribed at Portsmouth. The alterations in the building were very far from complete; workmen infested most of the rooms and passages; and bricks and mortar, shavings and sawdust, whitewash and paintpots were the signs of material progress and very material discomfort; but it had been determined that the College should be opened on the 1st of February, 1873, and it was opened.

With the Gunnery Lieutenants of whom I have spoken, I myself, as

their Instructor, was also transferred from Portsmouth; and for five months no other Instructor of any sort was appointed, except, indeed, the Instructor of Fortification, whose duties lay entirely with the Gunnery Lieutenants. But meantime, a great number of Half-pay Officers, understanding that the College was opened, applied to join, and were appointed. These, then, were placed under my instruction; my time was already very fully occupied, and I was directed simply to do the best I could without trenching on my primary duties as Instructor of the Gunnery Lieutenants. More joined, many more than were, I believe, at first expected: there were no Instructors except myself, and even if there had been, there was no room ready for them; there was thus nothing taught but mathematics, and that in a very broken and unsatisfactory manner. The Officers who had joined the College, probably in the expectation of finding it in full working order, were naturally a good deal disappointed; and it was at that time, and under such circumstances, that the report went abroad that mathematics—nothing but mathematics, was thought of or allowed.

But however true the report may have been, and to some extent was, in its origin, it is not true now. The hours appointed for organised study under the different Instructors are thirty-three in the week; of these sixteen are devoted to mathematics; the other seventeen are provided for at the option of each individual Officer; and whilst some elect to work on at mathematics, more especially the Gunnery Lieutenants, whose certificate, as such, depends almost entirely on the mathematical part of the examination, by far the greater number of Half-pay Officers apply the time to physics, chemistry, drawing, fortification, surveying, cartography, meteorology, international law, languages, or steam. There are also lectures on subjects connected with ship-building, such as applied mechanics, or stability of ships, which they are at liberty to attend.

Now, the thirty-three hours per week of which I have spoken is simply the time appointed for lectures or personal instruction; it does not represent thirty-three hours of solid work, and is not supposed to represent the whole time devoted to study; every Officer who joins the College with the real earnest intention of work may add to it as many hours as he can; and I think I am within very moderate bounds when I say that every Officer may and ought to have an average of twelve hours weekly. That is, however, at his own discretion; and if he chooses to spend the time rather at balls or theatres, he has certainly no right to accuse the College if the results at the end of the session are commensurate.

I consider, then, that we fairly claim from each earnest student forty-five hours in the week, of which sixteen are given to lectures and personal instruction in mathematics, seventeen to lectures and personal instruction in such other subjects as he may prefer, and twelve to private study at his own discretion.

I have thought that I might here properly introduce some account of the results of the examination held last June, at the end of our first Session. The marks were allotted to the different subjects as follows:—

Mathematics		3000
Physics		700
Chemistry		700
Steam		400
Marine surveying		300
Fortification		400
Military surveying and drawing		400
International law		250
Languages:—		
French	400	
German	350	
Spanish	350	
		1100
Freehand drawing		100
Total		7350

The number of marks obtained by the first four run thus:—

(1.) .... 3614, of which 2465 for mathematics.
(2.) .... 3301, of which 2418 for mathematics.

These were both Gunnery Lieutenants, and, as I have said, their special certificate is made, by Admiralty Order, to depend almost entirely on their mathematical numbers. Closely following these, however, we have—

(3.) .... 3245, of which 1543 for mathematics.
(4.) .... 3124, of which 1444 for mathematics.

These two were Half-pay Officers, who preferred making their numbers in other subjects; and as bearing directly on what I have been saying, I will mention one more, a Commander on half-pay, who stands on the list as (15), out of whose total of 1420, 181 only are due to mathematics. Now, as the limit for the College Certificate (the G of the Navy List) was fixed provisionally last year at 1200, it is quite clear that this Commander would have obtained that certificate, independently of his marks for mathematics, a subject to which—as a matter of fact within my own personal knowledge—he had, whilst at the College, paid little or no attention.

The course for the Gunnery Lieutenants is closely defined: it includes,—besides mathematics,—physics, fortification, and some part of military surveying. Other subjects are optional, though, as a general rule, they have not time for them. Of the Half-pay Officers I have referred to, (3) made his numbers in physics, chemistry, steam, international law, French, and German; (4) took up the same subjects, substituting marine surveying for German; and (15) amongst other subjects, obtained exceptionally high numbers in marine surveying and in French.

It is not by common report, nor by newspaper or magazine articles based on common report, that the work which we are doing is to be judged, when it can be brought to the exact measure of figures; and, as I have shown you, that of the numbers attainable in the final ex-

amination, considerably less than half are given for mathematics; that two Officers, taking a distinguished position in that examination, more than doubled the numbers which they obtained for mathematics; and that another carried off a certificate of merit without any mathematics at all; I think I have shown you also, that the outcry which has been raised about the excessive amount of mathematics studied at what is, you will remember, meant as and styled a strictly scientific College, is altogether unfounded. I may leave, then, this outcry to die of inanition; and having spoken at sufficient length of the necessity of mathematics, however elementary, as the basis of all scientific study, pass on to the discussion of other and more technical parts of our work.

Before doing so, however, as I have referred to the official report of the examination held at the end of the Session, I may with propriety speak of one cause which tends distinctly to keep down the average numbers obtained, and to show unfavourably the measure of our results. This is the very well known desire of the Officers on half-pay to get active employment; not only has that desire a continual unsettling influence, but the frequent gratification of it causes the division to be in a state of continual change. Officers get appointed to ships, and others are appointed to the College to fill up the vacancies. In this way many Officers who had made very satisfactory progress, some who would have taken a very distinguished place in the Class List, left us; and the new comers could seldom settle down to the work as well as if they had begun at the beginning of the Session. I think this is quite as it should be. It is of course disagreeable to the Instructors personally, and makes their work more onerous; but, on the other hand, it would be most prejudicial to the Service to have men pinned down to the class rooms, when there was employment for them afloat; and it would be most injurious to the College to have it supposed that it was in any way a hindrance to active employment. The alternation of students tells, of course, unfavourably on our lists, but so long as an Officer after, say, six months' study, carries away a fair equivalent as acquired knowledge, the advantage to the Service is gained, just as surely as if he remained for the examination and won a most brilliant G.

It is distinctly stated in the Admiralty Circular that "As regards "Officers on half-pay, my Lords are particularly anxious that young "Lieutenants should at once, on their promotion to that rank, avail "themselves of the advantages of the College before their turn would "come for appointment to a ship. The regulations specify allowances "which are intended to remove any pecuniary difficulties in attending "the College; and special consideration for appointments will be given "to Lieutenants who thus occupy in so useful a manner the time "necessarily spent on shore."

So far as the Lieutenants are concerned, this paragraph is being acted up to. Of the Lieutenants on half-pay now at the College, a very large proportion have been promoted within the last twelve months. There has been as yet little opportunity to see in what way the Admiralty will interpret their promise of "special consideration for appointments," and it would be evidently out of place for me to

speculate on their intentions; but, as a known fact, I may say that of the eight Lieutenants recently appointed for service with the Arctic Expedition, three were appointed actually from the College, and two others passed out from the College only eighteen months ago. If it is to be understood that these Officers owe their appointment in any way to the College, I think that their removal under such circumstances will give a far greater *impetus* to the cause of scientific instruction than even the additional G's which would, we may assume, have in due time appeared in the Navy List.

Returning then to our schedule. The study of physical science must be considered as to a great extent the experimental illustration of the truths of applied mathematics, and as the complement of mathematical study. We cannot suppose that any one will make extended progress in it unless he has a sufficient groundwork of mathematics; at any rate, I am quite sure that the mind whose powers have been strengthened and quickened by mathematical study will the better lay hold of and appreciate the grand physical laws. But even without any mathematical knowledge at all, the exposition and illustration of these laws must sweep away many pet forms of ignorance. Thus, for instance, a very favourite dogma amongst the uninstructed is that a man has a certain active power of suction. I assure you I am speaking within my own personal experience. I believe that comparatively few have had any real understanding of the principle of the barometer, or any capability of even attempting to understand its fluctuations. I believe—no, I am sure—that the laws of heat, light, and magnetism have been equally mysterious; while as to mechanics, I need but remind you of Mr. Reed's bitter remark, and the general though unpleasant feeling that there was a great deal of truth in it.

When we see the curious letters from Naval Officers that constantly appear in the daily or weekly papers, letters which betray—or, I should rather say, proudly display—an utter ignorance of the very first principles of mechanics or of hydrostatics, written by men who have grown grey amongst moving masses and displaced fluids; when we read the remarkable pamphlets which give too good grounds for sarcasm or sneer, what are we, who love and revere the Service, to do but to press most earnestly on our younger Officers the necessity of scientific study?

Chemistry is, perhaps, on a more independent footing than physics, simply so-called; it must, however, be regarded as a valuable auxiliary, and the two together have been rightly judged subjects most important to a Naval Officer, as bearing directly on the laws of equilibrium and motion, of heat, light, magnetism, electricity, and combustion, and as giving him an insight into the more modern appliances to move, or guide, or defend our own ships, or to destroy those of the enemy.

The importance to a Naval Officer of some knowledge of the steam-engine has long been admitted. Practically, of course, it can only be acquired by actual practice; but that practice will be rendered easier should it ever become necessary, by a previous acquaintance with its theoretical principles, with the physical laws on which it depends, and with the technical and detailed applications of these principles and laws.

I may here remind you of a case that actually occurred, of a Commanding Officer having to take charge of the engines; it was an exceptional case, no doubt; but it is for exceptional cases that a zealous and able Officer will wish to be exceptionally prepared. The case to which I refer was the homeward voyage of the "Fox," from the Arctic, in 1859, under Captain McClintock. The engineer and leading stoker had both died, and Captain McClintock himself did duty in the engine-room. I may add that Captain McClintock, to whose mechanical aptitude Arctic travel has been so deeply indebted, had many years before taken a very high class certificate, both in mathematics and in steam, at the Royal Naval College at Portsmouth.

I had intended to speak at some length on the subject of nautical surveying; but this has been so lately brought prominently before you by my friend the Superintendent of Charts, that I may advantageously condense what I had meant to say.[1] Of the work which there is for surveyors to do, and of the very meagre staff of surveyors to do it, Staff-Commander Hull has given you a correct, if unsatisfactory idea. As a practical surveyor, he has of course considered the subject more essentially from a practical point of view, and has urged the necessity, or rather the need of increased activity in this department of the public service. Such a map as he showed us the other night, is not flattering either to our geographical science, or to our reputation for maritime energy.

But whatever may be our own wishes or opinions, it is above all the duty of the College and of the whole staff of the College, to make the best of existing circumstances, and, so far as possible, to prepare for the future. If the economy or parsimony of the nation at large will not back up the desire of the Admiralty to carry on a more extended system of surveys; and if as the necessary result, our experienced surveyors, disappearing into the limbo of the retired list, become each year fewer and fewer, it is the more urgent on us to enable Officers to obtain as much insight into the mystery of the craft as can be learned without actual practice.

I have already spoken at such length of our mathematical course, that I am half afraid to mention the word mathematics again; but I cannot help myself. The principles of surveying are essentially mathematical, and the requirements of surveying gave rise—as the name teaches us—to the science of geometry. Surveying, then, is simply the application of geometrical problems, and, except on a very large scale, for the most part, as I have already said, of the problems of the first and third books of Euclid. As including the more exact methods of astronomy, it requires also a practical familiarity with the problems of spherical trigonometry, and with the different projections of the sphere. I know very well that there have been in time past many able surveyors whose theoretical knowledge of mathematics was extremely limited, and who by long practice and experience, earned by many blunders, gained a sort of instinctive acquaintance with easily demonstrable truths; but I would distinctly maintain that the energy and ability exercised in gaining this acquaintance were thrown away,

[1] The Unsurveyed World, 1874. By Staff-Commander Hull, R.N. *Vide* Journal, vol. xix, page 48, *et seq.*—Ed.

and that a timely devotion to theoretical study for six months would have more firmly and more accurately established it than the many years of labour and difficulty.

Mere practical knowledge, again, although perhaps sufficient for the ordinary work of a survey, has no power whatever to adopt new methods. As a special instance of what I mean, I may mention that very pretty and very practical application of one of the properties of the circle, now known as "the danger angle." This was introduced —if I am not mistaken—by Captain Shortland, one of the most capable, perhaps I should say *the* most capable mathematician in the Service. The "four point" method of measuring the distance of a shore or light is another purely mathematical innovation, which was certainly not hit off for the first time by any mere practical surveyor.

None the less, surveying must be considered as, to a great extent, a "handicraft." No amount of Euclid or trigonometry will, by itself, make a man a surveyor; he must learn also the ready use of the instruments,—the theodolite, the sextant, the compasses, the protractor, and the straight edge; until a man can observe an angle accurately, and protract it correctly, and that, as a matter of course, he cannot use the instruments. The work must be done quickly, neatly, and in a workmanlike manner. There are few, perhaps, who—given the observation —might not in a clumsy, left-handed way, and in the course of time, get it put on paper. That is not what we want. We want a cultivated judgment of the points to observe, a habit, an instinct almost, of observing accurately, and a straightforward certainty of interpreting these observations. Now all this we can and do teach at Greenwich, and we have convinced even that unsparing critic, the Superintendent of Charts, who acted last June as our examiner, that we teach it with very fair success, so much so, that out of 300 numbers awarded for the subject, one Officer obtained the whole 300, another 298, and altogether 11 obtained more than 250.

All this, of course, is not the "rose," but it has the charm of being very near it; and I am quite certain that when the good time, for which Staff-Commander Hull has expressed such longing, shall return, the Captains, Commanders, and Lieutenants wanted for surveying ships will be readily picked out of the annual dozen stamped in the Greenwich Mint.

Many of these will of course never have any opportunity of carrying their knowledge into practice, on any large scale; but the advantage to the Service in general, of having Officers who can correctly take and protract a round of angles; who can even correctly fix a position by cross bearings, and not note for the purpose—as I have known done— a pair of bearings diametrically opposite to each other; who can in time of war lay down the soundings with the least possible exposure, and in time of peace with the greatest possible accuracy—the advantage, I say, of having Officers so trained is inestimable; and if we succeed no farther than in impressing on them the use and intelligent practice of the danger angle, I believe that we shall have introduced a new element of safety into the ordinary course of navigation; if only in teaching them the real meaning of a chart, and in giving them a right appreciation and understanding of it, we shall have at any rate removed that dread

sense of mystery, which tells so heavily on the nerves of many Commanding Officers.

But do not suppose that I am saying that we can turn out finished surveyors; we do not pretend to do any such thing. We know, as well as others, that nothing but practice, hard, actual, long-continued practice, joined to natural aptitude and cultivated intelligence, can make a finished surveyor; but we know also, that an Officer who has gone through the careful and systematic training which we can give, has already overcome the first difficulties of practice, and is very far advanced towards overcoming the last.

Fortification and military surveying have been introduced, as part of the Gunnery Course, and for the benefit of the Marine Officers who are at the College. I have often heard it asked, What possible use can the study of fortification be to a Naval Officer? Surely, if at any time it may be his duty to attack fortifications, it is well that he should have some understanding of his possible enemy; but, not to trouble you with abstract speculations, I may say that within my own experience I have known Gunnery Officers called on to plan, to trace, and to superintend the construction of field-works for the defence of a position which was actually defended by those works for several months. I speak of the position which, under Sir Michael Seymour, we held at Canton during the autumn and winter of 1856. It was also in the same campaign, that after the capture of the Bogue Forts, the Gunnery Lieutenants of the squadron were directed to destroy them; and built as they were of very solid masses of concrete, it was a work that demanded not only the disciplined energy of the blue jacket, but the educated skill of the Officer.

Of International Law as a subject of study, it is almost needless for me to speak. That our Officers should know so much of the established rights and privileges of foreign ships in time of peace, and more especially of neutrals in time of war, as may enable them to steer clear of diplomatic embarrassments, is evidently a thing to be desired; and the course of lectures which has been delivered by the Right Honourable Montague Bernard was directed principally to that end. So far as these lectures have gone, they have pointed out what, under different circumstances, an Officer ought not to do, and what he incurs risk and special responsibility in doing; but there has been no attempt to point out what he ought to do, beyond such guidance as the elucidation of the authorised restrictions may imply. The object would appear to have been rather to buoy the channel than to take the helm; and in this I would say a judicious moderation has been exercised; for any attempt to control the decision of an Officer as to his positive action in time of emergency, would be certainly perilous, and, possibly, even disastrous.

As to foreign languages, the pertinence and necessity for their study has been admitted, I may say, by acclamation. There has even, I believe, been some feeling of dissatisfaction that more time has not been apportioned to it. It must be remembered that in learning any language, there is a great deal of downright dictionary work before the learner, which he must do by himself. So long as the Instructor

points out the grammatical difficulties and the peculiarities of construction, and by dictation or reading, conveys a correct idea of the pronunciation, it is nearly all that is possible; and if the exigencies of the College do cut the time with the Instructor rather short, there still remain the discretionary twelve hours per week, which may very well be devoted to the grammar and the dictionary.

But this time, you may say, has already been disposed of; it has been allotted to the independent study of mathematics, or of physics, or of chemistry. Very well then, the languages cannot be learned. A Naval Officer is only a man; a man, too, whose past life has not tended to quicken his studious faculties; he is not an Admirable Crichton, nor is it to be expected that in a Session of nine short months he is to become the embodiment of all human learning, the rival at once of Airy, Tyndall, and Max Müller. If during his residence at Greenwich he obtains a fair working mastery over any one new subject, or even obtains such an insight into it that he can afterwards continue the study unassisted, his time has been very well employed.

Of drawing it is unnecessary for me to say anything; but I may add to the subjects of which I have spoken and which appear in the scheme of the examination which I have placed before you, two others which have been included during the present Session, and will be duly represented in the next Examination. The one of these is Nautical Astronomy on a theoretical basis. This is of course distinctly a branch of mathematics, and will be considered as such, so far as the instruction is concerned; but it will, I understand, form a separate and optional subject for examination. The other is Nautical Meteorology, comprising the geographical distribution of barometric pressure, of prevailing winds and monsoons, of rains, calms, and storms, and with special reference to the law of cyclones.

This completes the present list. I am sorry to say so, for there is one subject which indeed is prominently named in the Admiralty Circular of 30th January, 1873, but which it has not yet been found advisable or practicable to introduce. The subject I mean is Naval History. Now it may be objected that history is not science, and that it cannot properly be included under the term "Scientific Instruction." From any such opinion I differ. Science is knowledge; accurate and exact knowledge, as distinguished from loose, vague, and empirical; and in this, the true sense of the word, history may be studied scientifically just as well as anything else. If the genesis of a plant or the habits of an insect are things worthy so to be studied, how much more are the words, and deeds, and destinies of our noblest and greatest men; and with a Navy such as ours, possessing such a history, it is a matter of very sad reproach that so few of our Officers are really well informed concerning it. I should be ashamed to guess at the very small percentage of Officers on the active list, who could correctly and intelligently discuss even the leading events of our annals; such say as the battles of Barfleur, or Quiberon Bay, or the First of June; Rodney's West Indian, or Sir Edward Hughes' East Indian campaign; Keppel's action off Ushant in 1778, or d'Orvilliers' cruise in the Channel in 1779.

A great deal has been said at different times about the study of tactics, but the scientific study of history is the study of tactics; it is a great deal more; it is the study of strategy, of organisation, and of discipline, and it is the only sound basis of that study. If it is admitted that these things can be studied, undoubtedly they can best be studied at the College, whose library, yet very imperfect, is backed up by the library of this Institution, and by the reading-room of the British Museum, both within easy reach.

But in speaking of tactics I am not speaking of manœuvres, evolutions, and signals; in speaking of discipline I am not speaking of seeing the defaulters at six bells: these are the means by which discipline is maintained, or by which tactics are realised, and cannot be studied except practically on board ship, and in an evolutionary squadron. In this sense the only effective instructor in the code of discipline is a taut Commanding Officer, the only real or possible professor of tactical evolutions is the Admiral commanding the Channel Fleet.

The division of Sub-Lieutenants is so closely connected with division B, not indeed by College course, but by the intrinsic necessity of the Service, that I pass on to it in natural sequence. At the present time, it consists of the following:—

Acting Lieutenant........................	1
Acting Sub-Lieutenants	80
Acting Navigating Sub-Lieutenants	12
Chaplains qualifying as Naval Instructors	2
In all	95

The scheme for the examination of Sub-Lieutenants has, as I have already said, and as is very generally known, been recently modified. As now fixed by the Admiralty, it is printed *in extenso* in the "Navy List," and it is therefore unnecessary to speak of it in detail. The course appointed for the Sub-Lieutenants at the College, previous to their examination, extends over six months; and it has been very freely objected that it is simply impossible for a young man to get even a smattering of the different subjects in that time. It has been forgotten, or ignored, that the time allowed him to prepare for the examination is not six months, but six years, and dates from his first entry on board the "Britannia" as a naval cadet; that every one of the subjects has formed part of the course of instruction for a great many years, and has been, for several years past, included in the intermediate examinations, if not in the final one. It is illogical to raise a cry, such as has been raised, about the injustice and cruelty of requiring young Officers to pass, at their final examination, in subjects which they have, all along, been required to pass in at their intermediate examinations; and if some of those subjects have been, in a measure, habitually evaded, the fact only proves the necessity of the step, which has now been taken, of bringing the neglected subjects more prominently forward. It is of course admitted that the carrying out these modifications will call

for much care and judgment on the part of the examiners; but until it has been shown that the examiners do not exercise that care, or are wanting in that judgment, the outcry that has been raised in some of the newspapers is, to say the least, premature.

It is, however, with the course preparatory to this final examination, so far as it relates to the College, that we are now concerned. It must, then, be understood that this course is not meant as complete in itself; it is the finishing touch to that long course of instruction which, as I have said, commences when the young Officer enters on board the "Britannia." Nevertheless, it must be acknowledged that, in very many cases, the results of that previous instruction are most unsatisfactory, and the number of candidates who join the College quite unprepared for the examination before them is sadly too large. This makes the work at the College much more severe than it ought to be, or than it is, by the Admiralty, supposed to be; and though we may hope that, as the system comes into more thorough working, and extends throughout the Service, this extreme pressure will stop; it weighs at present most heavily, both on the candidates themselves, and on the Instructors doing duty with them.

This pressure is most felt in those subjects in which the candidates are expected to be already prepared, and which, from their nature, require a long and laborious grounding; they have thus to devote the greater part of their time to these subjects, to the necessary neglect of the other subjects, for the study of which the College offers great opportunities. I do not hesitate to say that the arrangements made for the prosecution of these studies are most liberal, and the pressure, which doubtless does exist in the mathematical class rooms, falls rather on the Instructors than on the Officers under instruction.

In direct connection with this part of my subject, it seems right that I should refer to a point which has been, perhaps rather bitterly, discussed for some time back; the importance, namely, of the work done by Naval Instructors afloat. Now, I will not say that the present system is a good one; certainly it is an expensive one, and involves a great waste of teaching power; but so long as very young midshipmen serve their time in sea-going ships, I do not see in what respect it can be amended; when, however, it is argued that the work with the Naval Instructor is not more than six or eight hours weekly, and it is implied that no results worth having can reasonably be expected from six or eight hours' work in the week, I would say very emphatically that the implication is not correct; that at schools on shore, schools that annually send up men to Cambridge to compete for scholarships, six or eight hours a-week is counted sufficient time to allow to mathematics, even for the advanced pupils; and that any boy of sixteen ought to be able with that amount of work, to make satisfactory progress; that many do so, I know from my own experience; that very many do not, I also know; and it is not difficult to find out the reason why they do not. The instruction on board the "Britannia," earnestly and laboriously given, results in *cram*, not in knowledge; the cadets, as they join the sea-going ships, are most frequently puffed up with conceit and ignorance; they do not even know enough to be sensible that

they know nothing. Their idea is that they have escaped from school, and whatever they may have been in the "Britannia," are at any rate Officers at last. The idea is most natural, and if only it could be fully carried out, would be most beneficial. They have passed what appears a very high, and is undoubtedly a very severe examination; they have, probably enough, been commended by one of the Lords of the Admiralty, and have received not only gorgeous prizes, but the coveted white patch. They ought to be so far advanced as to retain with ease what they have been taught. But they are not. Their course with the Naval Instructor is thus too frequently unsatisfactory; a disappointment in the beginning, a drudgery to the end.

Whether it is the purpose of the Admiralty to continue Naval Instructors in sea-going ships, I do not know. The recommendations of the Naval Cadets Committee seem clearly in favour of their being continued, fully accepting the conditions that six or eight hours a-week is as much time as a cadet or midshipman ought to, or can, give. But when youngsters, properly grounded, attend school rather to have their previous knowledge turned to account, and to be taught, with reference to it, the practical applications of theory, the time will no longer be an abomination and a weariness, but an intellectual pleasure, and I think that under such conditions the work of the Naval Instructor will bring forth very abundant fruit.

I come now to speak of Division A, which consists, you will remember, of engineer Officers, students of naval architecture, and private students, amongst whom are included Officers of foreign services selected by their respective governments. The following is a tabular statement of those at present included in this division:—

Chief Engineers	2
Engineers	8
First Class Assistant-Engineer	1
Second Class Assistant-Engineers....	24
Students of Naval Architecture	8
Private students	1
Foreign Officers and students........	7
Being a total of	51

Of these, the Second Class Assistant-Engineers are sent up from the dockyards on the completion of their time as engineer students. The conditions for their entry by examination before the Civil Service Commissioners, you will find in the Circular of the 30th January, 1873, to which I have already so often referred, and which is in fact the Charter of the College. I must, however, ask your forgiveness if I quote one or two sentences from it.

"Engineer students will remain for six years at the dockyards for "practical training in the factories, the fitting and erecting shops, and "to receive instruction in iron ship-building. They will pass a portion of their time in the drawing office and at the dockyard "schools."

I may here remark that this time at the dockyard schools is limited to two afternoons and three evenings, that is to say eleven hours in the week, during the first four years of their service. During the last two years they do not attend school, except occasionally in the evening. I again quote from the Circular.

" All the engineer students will be examined, as to their theoretical " and practical qualifications, on the completion of their time at the " dockyards, and those found qualified will proceed to Greenwich as " acting second-class assistant engineers.

" Those engineer students who fail to pass this examination will be " allowed to remain one year longer at the dockyards, and then be re- " examined, when, if they are unable to pass, they will cease to be " eligible for the rank of naval engineer.

" Acting second-class assistant engineers will remain at Greenwich " for one session for study. They will be examined on the completion " of the session. Four acting second-class assistant engineers will be " selected from those who take the highest place at the examination, " to pass through a further course of scientific instruction.

" These four will be examined at the end of the second session, and " one or more will, at the discretion of the Admiralty, be allowed to " remain a third session, on the completion of which they will be sent " to sea as second-class assistant engineers, and after one year's service " at sea, they will be considered eligible to fill positions in the dock- " yards and at the Admiralty."

Now I have read to you these *excerpta* from the Admiralty Circular to show you how earnest is the desire to have thoroughly capable and scientifically instructed men, and these only, in the Service, as engineer Officers. The standard which we hope systematically to obtain, and which, as a matter of fact, we do obtain, is exceptionally high; in mathematics especially there is no department of the public service in which the standard even approaches that which is reached by our best men, a standard which—though not so general—is, in its special subjects, on a par with the high honour papers at Cambridge.[1] And it is not only in mathematical, or purely theoretical subjects, that this high standard is obtained. The examination includes also applied mechanics and strength of materials, theory of waves, theory of the steam-engine, physics, and chemistry. I would only add that though these advanced students of last year were transferred from South Kensington, we are led, by the promise of those who have entered under the new regulations, to believe that our future standard will rather exceed than fall short of this first essay.

The final examination for the students of naval architecture is, in its main features, the same as that for the engineers. The number of these admitted to the College is however small, and the selection is previously made in the dockyards. Three, so chosen by competitive examination, are sent up each year, and these remain the three years,

[1] Professor Lambert, the examiner of Division A, last June, tells me that, taking into account the different nature of the examination, he would consider the best of these men as equal to a place amongst the first ten Wranglers.

fellow-students of the engineers; the course of instruction differing only in some points of technical detail, which it would be tedious here to specify. According to the Circular, they "must join with their "parents or guardians in a bond for the sum of £250 to serve under "the Admiralty for seven years, if required, after the completion of "their apprenticeship."

It is not too much to say that this regular supply of highly educated and scientific men to the ranks of naval architects must be attended with the happiest results, not only to the Royal Navy, but to the mercantile marine; for it is not to be supposed that, as they gain experience, they will remain contented in the subordinate positions to which their mere numbers will necessarily limit most of them, whilst serving under the Admiralty. If, for its own wants, the Royal Navy can permanently attach to itself those of exceptional ability, supported by a staff of highly-trained juniors recruited each year, the whole shipping interest of the country will be directly and incalculably benefited by the services of many for whom there is not adequate employment under the Crown. The welfare and strength of the Navy is so bound up with the general prosperity of our merchant shipping and with the safety of our sailors, that we may feel a very high degree of satisfaction at the prospects before us of the ship-building work of the country coming thus into the hands of scientific men; and it is not difficult to picture to ourselves the good time when appalling catastrophes, such as have so often during the last ten years spread dismay amongst our seamen and carried mourning to many a fireside, may be memories of a distant past.

I have thus endeavoured to set before you an account of the present state of Scientific Instruction in the Navy, and a perhaps speculative view of the future. I have described to you the organisation and working of the Royal Naval College, the obstacles which stand in our way, and the difficulties we have to contend with. Not the least of these is an unreasoning prejudice which would seem to have been called into being by the peculiar circumstances under which the College was opened, and to have been fostered by obscure newsmongers for their own ends. If what I have said this evening should help in any way to remove this prejudice, I shall have done the cause of education good service, for it is impossible to doubt that it has, in some way, tended to prevent senior Officers joining the College. When we compare the numbers of Captains and Commanders who used to crowd to the old College at Portsmouth, with the very small numbers who have joined us at Greenwich, where the accommodation in respect to comfort and convenience is far superior, the difference—even allowing for the present reduced state of the lists—is too noticeable not to force on us the conclusion that they are deterred by some feeling such as I have spoken of. The Admiralty Circular declares the College open to receive twenty-five Captains and Commanders; at the present time there are only seven.

As I have had occasion to mention the old College at Portsmouth, I will with your permission say, in conclusion, a few words relative to the

change which has been made. The writer in "Naval Science," to whom I have already referred, has said, "We have no hesitation in saying "that the late Naval College at Portsmouth was calculated to do more "real service to the Naval profession in its older members than its "more ambitious successor at Greenwich is yet doing."

I must say that in this I do not agree with him. I had myself the honour of being attached to the College at Portsmouth for more than six years, and I know more intimately than any Officer now serving—more intimately perhaps than any man now living, with the exception of my esteemed friend Professor Main—what that College did do and could do; what it did not do, and could not do. You will certainly not hear a word from me in disparagement of the old College, considered as a seat of instruction, and not as a poky little building full of draughts and bad ventilation, and foul drains and sickening stenches. The building I certainly disliked, and shudder at the memory of it; but of the College I have a most affectionate recollection. I think now, and always have thought, that Portsmouth possesses many advantages as a centre of naval science; and with adequate accommodation and an adequate expenditure I believe that the College at Portsmouth would have been in no respect inferior; but, as a matter of fact, there was not the accommodation which was ready to hand at Greenwich, and the Admiralty refused to sanction any increased expenditure. The estimates for the College at Portsmouth amounted to something like £6,500; at Greenwich they are about £35,000; and we must be working on a very false principle indeed, if we do not obtain results, not perhaps proportionate to the increased expenditure, but still very considerably increased. That, as far as the Senior Officers are concerned, seven Captains or Commanders at Greenwich are deriving as much advantage in the aggregate, as twenty-five did at Portsmouth, I am not prepared to maintain; and so long as Officers of these grades shun the College, it is not doing its wished-for maximum of work; but as far as they are individually concerned, I believe we get them to study for a greater number of hours—if only for this one reason, that the air of the class-rooms is fresh and wholesome, which certainly could not be predicated of the large study at Portsmouth.

The burgesses and tradesmen of Portsmouth felt that the departure of the College was a real pecuniary grievance, and a great deal of the nonsense which was talked about the change arose from this very disinterested source. They seemed to think that they had a vested interest in the College, and that the instruction of Naval Officers ought to be subservient to the advantage of their pockets. I will only refer to the rumour that was got up, that Portsmouth was to be punished for electing a Conservative Member; Greenwich was to be rewarded for having given a seat to the then Prime Minister. I cannot, of course, say that such ideas never entered the Prime Minister's head; but this I may say, that if they did, the very ungrateful borough of Greenwich has not appreciated them.

The CHAIRMAN: We shall be happy to hear any gentleman who may wish to offer remarks on the interesting paper which we have just heard.

Lieutenant BOWER, R.N.: Professor Laughton has drawn attention to the subject

of naval tactics, and he seems to think, with a great many other naval Officers, that we are unable to study the subject at Greenwich, and that our studies on the subject should be confined to past history. Now I do not think that we can learn very much by studying the deeds of our ancestors. In the matter of tactics I fancy they made a great many blunders that we ought not to repeat, and their tactics are quite unsuited to the ships employed at present. Still I do not think the subject of tactics must necessarily be excluded from the subjects of the College. Perhaps I ought to say what I mean by tactics. Tactics, as I understand them, are not mere evolutions, but manœuvres on a field of battle, by which we endeavour to outwit and overcome an enemy. An enemy's formation is limited to a certain number of mathematical figures, and as we can consider every formation that it is possible for an enemy to get into, so we can consider the formations we ought to endeavour to adopt to outwit and overcome them.

Connected with this, there is another subject to which Professor Laughton alluded, viz., fortifications. The fortifications all over the world are at present being modified to suit the requirements of modern artillery. The Prussians are fortifying the harbours of Kehl and Wilhelmshaven, and preparing, I suppose, for something. It is quite possible we may never be called upon to attack those forts, but their calculations are made for somebody. Now we gunnery Lieutenants at the Naval College only study the subject of field fortifications; of the subject of permanent fortifications we profess to know nothing. I do think we ought to give some attention to it, in view of the preparations that are being made abroad, perhaps for our benefit.

Another subject mentioned was foreign languages. We cannot study much at the College the question of foreign languages; our time is too limited; and a foreign language is a subject that requires a lifetime. But when a midshipman is abroad, there are many stations where foreign languages can be studied, such as in the Mediterranean, India, and other places, where instruction can be obtained for a very little expense during the stay of the vessel. Midshipmen are not likely to expend their small pocket money in procuring a foreign instructor, but I do think the Captain of the ship might be authorised to expend a certain amount of money in providing a foreign instructor from the shore to teach foreign languages. That we should compare so unfavourably with foreign nations in this respect, is not creditable to a nation or a Navy such as ours.

Another subject to which Professor Laughton alluded, was the letters and pamphlets written by naval Officers, but he omitted to speak of the very remarkable language in which they are sometimes written. Now a midshipman on going to sea at 12 years of age drops the study of the English language entirely, and I suppose never looks at it again—at least very few do, and much valuable information is lost to the country and to the service generally from Officers being unable to put their opinions and the facts that they have acquired, into good readable English. From the very nature of an Officer's service in the Navy, he has opportunities of visiting places and of seeing things that other people have not, and I believe that were Officers instructed in their own language, much information would be gained to the country generally. It will be said there is not enough time to admit of a course of mathematics and a course of languages as well. But when the midshipman becomes a Sub-Lieutenant, why not go on as a Sub-Lieutenant? I am sure it only requires to be commenced, for Officers to avail themselves of it.

Then as to the question of mathematics for Gunnery-Lieutenants. During our time at College, we learn a certain amount of mathematics, but we feel, even if we should qualify as Gunnery-Lieutenants, that we compare unfavourably with artillery Officers in any discussion that may arise as to naval ordnance. Although we learn mathematics at College, we do not learn how to apply the knowledge we have acquired—I mean as far as expanding gases, strength of materials, metallurgy, gunpowder, chemistry, and other points are involved. Were the present course for Gunnery-Lieutenants extended for another nine months, as is the case for the advanced class of artillery at Woolwich, we might gain in the Service, what we have not at present, a class of practical artillery Officers able to hold their own in this Institution and in other places with the artillery Officers of the other branch of the Service. I do not know that there is any other subject to which I need allude. I

felt, however, so strongly upon the subject of naval tactics that I could not omit mentioning it.

Captain NEEDHAM, R.M.L.A.: I merely wish to correct a statement made by the last speaker, when he said that no instruction is given in permanent fortifications at the Royal Naval College. I think I am right in saying that two afternoons in the week are devoted to the subject, and I suppose it is quite open to any Lieutenant to attend those classes if he pleases.

Lieutenant BOWER: It would be done at the risk of losing mathematics.[1] He would have to give up a certain amount of mathematical instruction to do so, and that he cannot afford to do.

Mr. ECKERSLEY, Chief Engineer, R.N.: I was very glad to hear Mr. Laughton at the end of his paper make a remark differing somewhat from what he had said in the previous part. At first he stated—at least, so I inferred—that to this country the scientific education of engineers was of no moment, and afterwards he qualified it by stating that it was. Now, having served at sea some 20 years, I know this country has lost an immensity of money through her engineers not being thoroughly educated. The Admiralty have now struck a good, deep, and honest blow in educating those men who must be the right hand of the Captains and Commanders of our future navies. When I joined the Service, during the Russian war, the Admiralty sent round the country soliciting for engineers; they obtained them, but they were not well treated; and the records at the Admiralty would show hundreds of blunders simply caused by the non-education of those men. Since then, the engineers are educated both in pure and applied mathematics. I did not hear Mr. Laughton speak of a Professor joined with Professor Miller (the Professor of applied mathematics). In our future naval warfare there is no doubt that the turrets, the guns, and the very hull of the ship itself will become smashed, knocked about, or battered, and if these persons know well how to apply the theoretical knowledge which they have gained there, it will repay, I am sure, the money spent upon their education at Greenwich.

Rev. J. B. HARBORD: I should like to say a good word in favour of the "Britannia," for I think an impression might go abroad that a considerable amount of blame is attached to her: I ascribe the difficulties the naval instructors of the fleet have met with, not so much to the shortcomings of the training ship as to the mathematical and theoretical subjects which they were expected to give instruction in afloat, being wholly dropped out at the final examination for the rank of Lieutenant. All the Naval Instructors in the world cannot alter human nature, and as midshipmen were not examined in Euclid and algebra, no power on earth could force them to study these subjects. A few years ago the two great defects in naval educational arrangements were the short course in the "Britannia," and the fact of these subjects that I have alluded to, finding no place in the final examination. The consequence was, that the knowledge of the midshipmen varied inversely with the period elapsed since they had left the training ship. I have grounds for knowing that this is no longer the case. The extended period of study on board the "Britannia" has already borne its fruits in the knowledge there acquired being more sound, so as to form a solid basis for future improvement; and we have seen that all the subjects which are requisite for a solid foundation to a scientific education now find a place in the final examination. I am quite sure better results will follow in future—that the Sub-Lieutenants will enter the College far better prepared and more fitted to take advantage of the opportunities which Greenwich affords.

The CHAIRMAN: I think we can best close the proceedings by giving our thanks to Mr. Laughton for his very interesting lecture. I need only say we shall couple the word "instruction" better with the Royal Naval College of Greenwich than the word "science," which seems to set everybody's teeth on edge.

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[1] My point is not that permanent fortification is not taught. I am aware that it is taught to Officers of the Royal Marine Artillery, but that it is not taught to gunnery Officers, or included in their course of study.—G.B.

LECTURE.

Friday, February 19th, 1875.

FIELD-MARSHAL H.R.H. the DUKE OF CAMBRIDGE, K.G., G.C.H., &c., &c., &c., &c., Commanding-in-Chief, President of the Institution, in the Chair.

THE INTELLIGENCE DUTIES OF THE STAFF ABROAD AND AT HOME.

By Major C. B. BRACKENBURY, R.A., D.A.Q.M.G.

BEFORE entering upon the main subject of the lecture which the Council of this Institution has called upon me to deliver to-day, it appears necessary to define the meaning of the term "Intelligence duties of the Staff," and to show why attention to them has of late become especially necessary. That "Intelligence" is not used in the sense of quick understanding, but in that of information, is, I believe, sufficiently understood; but the character of the information is not yet entirely plain to all minds. For instance, letters occasionally arrive from anxious persons who desire to know why John Smith or Thomas Atkinson has ceased to write to his affectionate but afflicted relatives. To take no notice of such communications would be simple but cruel, and valuable time is spent in referring the questions to commanding officers, who alone can deal with them properly.

Again, a paragraph appeared a few weeks ago in a morning paper, speaking of a class having been formed at Woolwich by the Intelligence Branch, for the instruction of officers in reconnaissance duties. Really the Intelligence Branch must not be supposed to be in competition with the able departments for military education.

By the "Intelligence duties of the Staff" are to be understood:—

Firstly, the collection, sifting, and arrangement of all information required by Governments and military authorities to enable them to take such measures in peace as will insure the rapid commencement and vigorous prosecution of any war whether at home or abroad.

Secondly, the diffusion of necessary or useful military information through the army and the country during peace or war.

Now, in proportion to the advancement of civilization, the machinery of war becomes more complicated, more costly, and swifter in its work. The necessity for readiness becomes every day more absolute, while the means for obtaining the latest information grow with the growth of armies and with those helps to swift action, roads, railways, and telegraphs. Let us spare a moment to compare the wars of ancient and modern times.

Herodotus relates that Crœsus, desiring to check the growing power of Persia, set about preparing for war. First of all, with laudable caution, he put no less than seven oracles in different places,

through a competitive examination, by asking them what he himself was doing on a certain day. Having selected the Pythian Apollo at Delphi and another, he offered as a propitiatory sacrifice three thousand victims, together with much gold and silver, on one flaming pile. Out of the metal so melted he made certain images, amongst them a lion of pure gold. These and other offerings he sent to the temples, and asked whether he might attack Persia, and, if so, whether he should seek the help of allies. Both oracles said that if he marched against Persia he would "overthrow a mighty empire," and they concurred in the practical advice that he should form alliances with the strongest States in Greece. Upon this he made presents to all the inhabitants of Delphi, and sent a third time to ask if his power would be perpetual. The answer was, yes, till a mule should reign over the Medes. Then he had to find out which were the most powerful States in Greece. Satisfied on this point, he sought their alliance, gained it, prepared an army, and at last marched—to his ruin. When he, a prisoner in the hands of Cyrus, sent to reproach the oracle which had lured him to his destruction, he was told that he had been in too great a hurry, for if he had further asked what empire it was that he would destroy, he might have learnt that it was his own. Such was the Intelligence Department consulted in the old days, and such the leisurely preparation for war.

As for the speed of carrying out a campaign in ancient times, we will take only take one instance also from Herodotus. Cyrus, advancing upon Babylon, came to a river. In crossing it, one of the sacred white horses was drowned. The enraged warrior swore that he would make the river so insignificant that women should be able to cross it without wetting their knees. He carried out his purpose by diverting the stream into 180 trenches, but he spent a whole summer in the operation. Fancy the Germans stopping to bully the Saar or Mozelle in 1870, because the then King of Prussia had lost a favourite horse, or even a clergyman, in the passage.

In the middle ages war was a chronic disease, never ceasing, never entirely exhausting. There was no general staff, no maps nor statistics to be studied. Later on came the Thirty Years' War, slow and barbarous. An idle and oppressive soldiery lived luxuriously on the fruits of the people's industry, and were, in truth, little better than organized robbers. The Seven Years' War was more scientific, but still slow, and was rather a king's game than an international struggle.

The French Revolution produced enthusiastic soldiers and brilliant commanders, but it was reserved for Napoleon I to show what could be done by a man of genius, aided by a staff trained under his own eye. It was a grand achievement when, in 1805, he marched a large army from Boulogne to the Rhine in 26 days; but that army had been long in forming, and had been worked as an army for a considerable period. The same military genius arrived in Paris on the 19th March, 1815, found an army of 155,000 men ready to his hand, and by the 1st of June had raised it to 250,000 of whom 128,000 were on the Belgian frontier. The constitution of the French Army of Italy, in 1859, was commenced early in February, war was declared

on 23rd April, and, 37 days after, 104,000 French soldiers were collected on the river Po, with 12,000 more in Italy, but behind them. At no time did the French Army of Italy exceed 130,000 men and 432 guns, and this army bore but a small proportion to the force France was supposed to possess on paper. We see here, however, an extraordinary advance in the possible rapidity of making war. But what is this to 1866 and 1870? In 1866, Prussian armies, numbering 220,000 men were placed on the frontiers of Saxony and Silesia in a fortnight; and in 1870, Germany, taken by surprise, mobilized her enormous forces in nine days, and had on the French frontier in eight days more, about 400,000 fighting men and 1,200 guns. The labours of the German Staff have since been directed towards arriving at still greater rapidity; and it may be confidently expected that a future campaign would see the mobilization and concentration performed in a period shorter by some days. The French are aiming at the same mark, and it is no extravagant supposition to conceive the face of Europe signally changed within a month from the outbreak of another war. For, in future, not armies, but nations, will meet in the first shock of battle.

It is vain for us to quote the experience of Wellington's Peninsular campaigns or the Crimean war; for, in the former, there were no railways nor telegraphs, and, in the latter, Russia had none that were of any use to her. Now she has many, and they are all designed with a view to military requirements. Surely this extraordinary development of speed in making war, demands some further preparation than used to be sufficient. Surely it demands that we should watch more carefully, and prepare ourselves more assiduously than has been the custom heretofore.

Let it not be supposed that there is some occult means by which neglect in peace could be atoned for in war. If the required information be not ready, it cannot be suddenly obtained.

Mr. Kinglake quotes Lord Raglan's despatch to the Duke of Newcastle, announcing his and Marshal St. Arnaud's acquiescence in the wish of the Home Governments that the Crimea should be invaded. In the despatch the English General says, "The fact must not be concealed, " that neither the English nor the French Admirals have been able to " obtain any intelligence on which they can rely with respect to the " army which the Russians may destine for operations in the field, or " to the number of troops allotted for the defence of Sebastopol; and " Marshal St. Arnaud and myself are equally deficient in information " upon these all-important questions, and there would seem to be no " chance of our acquiring it."

At the time when this despatch was written, the Prussian organization, presently to be described, had been in existence for nearly forty years.

Supposing it granted that previous knowledge and preparation are growing more and more necessary for success in war, let us see what sort of knowledge is required by any country; for instance, our own.

First of all we ought to know our resources in men, arms, horses, and money. We ought to know, exactly, what troops, reserve or other-

wise, must be retained at home for the defence of the country, and such troops should be always assigned to the places they are to occupy. They should be definitely organized, as they must be in war, for why should we leave such simple, but tedious questions, to a time when all our energies should be free? Next, we must know the military features of our own country, and have thought over them so much, and turned them over in our minds so often in connection with the disposable force, that there can be no difficulty in deciding upon the plan of the defence; no hurry or indecision at the last moment. Garrisons having already been told off to their places, the great bulk of the remaining troops will form a field army. Its strength, organization, and means of supply may all be arranged at leisure during peace; and, finally, we must know what expeditionary force is available for a counter-stroke against the enemy's territory.

This expeditionary force should be told off now in time of peace, so that nothing will remain to be done but the periodical substitution of regiments, as they relieve each other in the ordinary course. The force should be definitely organized on paper with all its material and transport. The railways or roads by which it will move to concentrate on the coast should be specified, and the exact number of trains or days marches should be settled. The amount of tonnage required for its sea transport should be calculated, and the character of the various ships decided while there is plenty of time to think the subject out quietly. Even the boats required for embarking and disembarking should not be forgotten, nor the means of supply for the first few days. In short, the Staff ought always to be prepared with a definite answer to the questions—"How many troops are available for a movement on such a country (perhaps to the assistance of one of the colonies), and how soon can they be landed at the point of disembarkation, ready to commence a campaign?" This is no more and no less than all continental nations are prepared to do. They call the work, so far, "Mobilization" and "Concentration."

Arrived on the enemy's territory, or our own colony which is to be defended—the commander of the expeditionary force should not be like a stranger in a forest, nor as our gallant comrades were when they arrived on the Gold Coast. The information required for the successful and economical prosecution of war is obtained with comparatively little difficulty during peace, and should be ready in a concentrated form when war breaks out. It is of exactly the same character as that needed at home for home defence; only we must have also knowledge of the enemy's preparations, and such information is obtained more easily by the invader than the invaded, because the invader chooses his own time. This is one great advantage of the offensive in war. Finally, the commander should have his plan of campaign in readiness, so that his first blows may be struck at once. All these preparations may be so made at leisure, in peace, as to await only the last touch according to circumstances when war is imminent. The Army should be well supplied with maps, and carefully compiled military handbooks of the country. In Prussia, Austria, France, the minor States of Germany, and, I believe, in almost all other European countries, the

work above sketched is done by the "General Staff," and I now proceed to describe how they do it.

PRUSSIA.

The Prussian "Great General Staff" is the first to engage our attention, both because it has existed almost in its present form since the beginning of the great peace, having been organized in 1816, and because those of other countries have been formed on its model though with slight modifications.

The principles on which its founders and successive chiefs have acted, are, that the Officers composing it must be the very cream of the Army in talent, conduct, education, and physical as well as mental power, and that all arms must be represented. There is an excellent school for the development of the higher qualifications of Officers called the War Academy, which is, in many respects, like our Staff College; but neither does it furnish the whole of the candidates for Staff employment, nor is the successful accomplishment of its course considered to give any claim whatever to appointment. It is true that some of the best scholars of the War Academy, are annually chosen to work under Count Moltke, but with them there are always other Officers recommended by Colonels of regiments. No pupil, leaving the War Academy, knows whether he will be one of the chosen. All return to their regiments, and those selected are afterwards summoned to Berlin, where, together with the Officers sent up from regiments by their Colonels, they are placed for a year under the immediate eye of Count Moltke, who tests their abilities by giving them tasks to perform such as are the usual work of the Great General Staff. After the year they all return to their regiments. A few months elapse and then the best of them receive the rank of Captain on the Staff, putting on Staff uniform for the first time. Some of them are allotted to the corps or divisions, others to the Great General Staff at Berlin. In all cases the chosen ones are employed on real Staff duties, and the greatest care is taken, in the case of all Staff Officers, *not to cloud their faculties by too much routine labour at the desk*. Such routine work as is necessary is performed by a class of Officers called Adjutants, who form a corps distinct from that of the Staff though recruited to a great extent from the Officers who have passed through the Staff course. Bear in mind, if you please, this question of Adjutants for office work. We shall meet with it again hereafter.

The Staff Captains, whether attached to the Great General Staff at Berlin, or to corps and divisions, are kept perpetually engaged either in surveying, reconnaissance, acquisition and arrangement of information, or in duties having direct reference to the conduct of troops in the field.

After four or five years of Staff service they return to regimental duty; and, later on, part of them only are selected as Majors on the Staff. These fortunate ones have, by this time, gained some seven or eight years' promotion above their regimental comrades. But there is little or no jealousy, for their tests have been severe, and everyone has confidence in Count Moltke.

Promotion to the rank of Lieutenant-Colonel and Colonel goes in the Staff, and the successful Staff Officer thus reaches the command of a regiment some years before he would have done so if he had remained what is, by a strange misnomer, sometimes called amongst us "at his duty." Surely a hardworking Staff Officer is as much "at his duty" as he is who has remained with his regiment. The latter has doubtless done his duty in his sphere of action. So has the former, and his sphere has been a wider one, his work more severe.

Thus it may be said that the only passport to the Prussian Staff is hard work, the only admitted claim to remain in it is that of approved power. The system has found such favour in the eyes of other nations that it is likely to be adopted with very little alteration by both France and Austria.

Having thus watched the accumulation of a large body of highly qualified Staff Officers, let us now see how they are employed in peace. The first great fact is that all their labours are directed to one end—preparation for war—and that so thoroughly that there is nothing left unprepared when the time of trial comes. Prussia, and therefore, Germany, can never be caught unawares. She is always and absolutely ready. It has been said that when war is declared, Count Moltke has only to touch a bell and the machine is set in motion. If for Count Moltke's name we substitute that of the War Minister, and for the bell a few telegraphic messages, the metaphor becomes a simple fact. Nor is there anything secret or incomprehensible about the means. The only wonder is that all nations did not know the fact and prepare themselves in like manner long ago. You know that each detail of mobilization is arranged beforehand so that the Army Corps are immediately raised to their war strength by their Commanders. The rest of the preparation is worked out by the Great General Staff at Berlin. What are its organization and action?

Great General Staff at Berlin.

At its head is Count Moltke, whose name will shine the brighter as history grows older. He and his subordinates have nothing to do with the War Office, except to supply it with any information it may require. Nor have they anything to do with the troops except the Railway battalion, a sort of nucleus for railway studies in peace. Of this battalion Count Moltke is Inspector. The celebrated chief and his band of workers occupy a magnificent palace lately built outside the Brandenburg Gate, at Berlin. Bearing in mind that Bavaria and other German States have similar establishments, it is not a little remarkable that Count Moltke has under his hand, exclusive of all Staff Officers doing duty with the troops; exclusive of Officers permanently employed on the survey of the country; exclusive also of the establishment of the Minister of War,—no less than from 91 to 101 trained Officers always at work on the studies considered necessary as preparation for war. The number is made up by 61 chiefs of sections, Field Officers and Captains actually on the Staff, and 30 to 40 Officers who have been trained at the War Academy or recommended by their Colonels. There are, besides, 115 employés such as

registrars, draughtsmen, printers, &c., but I think that, for the purposes of this lecture, we had better confine ourselves to the Officers.

The 61 Staff Officers belong to two classes:—

1st. The Active Staff liable to service with corps and divisions in their turn.

2nd. The *Neben Etat*, or accessory establishment, consisting of Officers noted for special scientific acquirements, who are content to relinquish the chances of distinction in the field for the solid advantage of permanent employment at Berlin.

During peace the Great General Staff is thus divided:—

Central Bureau, and
A. The Three Sections.
B. „ Railway Section.
C. „ Section for Military History.
D. „ Geographical Statistical Section.
E. „ Topographical Section } about to be amalgamated.
F. „ Office of Land Triangulation }
G. „ Intelligence Office.
H. „ The Map Room.

Central Bureau.

Count Moltke has two adjutants who, with a secretary and staff of clerks, conduct the whole of the correspondence of the Great General Staff. The first adjutant makes a daily report to his chief on the progress of business and has charge of all personal affairs.

A.—*The Three Sections.*

The business of the Three Sections is to collect from all available sources the latest information concerning European Armies, to follow all their changes in organization and to keep up to date systematized information concerning them. They are also bound to issue periodical descriptions of those armies for the use of the General Staff.

The First Section has charge of what is called the Eastern theatre of War, comprising Austria, Russia, Denmark, the Turkish Empire, Greece, Asia.

The Second Section has charge of the Central theatre of War, comprising Germany, Italy, Switzerland.

The Third Section has charge of the Western theatre of War, comprising France, Great Britain, Belgium, the Netherlands, Spain, Portugal and America.

Colonies go with the countries to which they belong.

You will observe that the Three Sections devote their attention especially to foreign *armies*.

B.—*Railway Section.*

Collects and arranges systematically all information on railways at home and abroad, especially with regard to their capacity for carrying troops. Upon this information the section works out:—

First. Instructions for the transport of troops and munitions of war.

Second. Plans for transport of the German forces under different suppositions so that the German Army may, in the event of war, be concentrated upon any point likely to be threatened, with the greatest possible speed.

Third. Examination of all projects for new railways.

A short railway line has lately been constructed near Berlin, with the avowed object of practising during peace the military use or destruction of railways during war. Different time tables are compiled by this section and kept up to date, so that, at the moment of war, there is not the slightest doubt as to the day or the hour when particular corps, or parts of corps will arrive at the destined point of concentration. But, like all German military institutions, the work of the Railway Section is so prepared as to be elastic. In 1870, the sudden declaration of war by the French led to the supposition that they would invade and occupy the Palatinate before the German Army could concentrate there. Subsequently the inaction of the French enabled some of the German troops to be carried on by the trains which had at first been ordered to halt on the hither side of the Rhine. The railway battalion is under this section.

C.—*Section for Military History.*

It is unnecessary to point out the practical value of the study of military history. Fully impressed with its importance, a section of the Great General Staff devotes itself to the accumulation and arrangement of historical records, and the preparation of excellent histories of great wars. The annals of Prussia have of late been so rich in materials that the Historical Section has been kept hard at work upon the wars of our own time.

D.—*Geographical Statistical Section.*

The duties of this section are to collect and arrange all information of military value bearing on the topography and statistics of foreign nations, as well as the statistics of Germany. It works in close connection with the Topographical Section, out of which it was developed a few years ago. As the Three Sections devote their attention to armies, so does the Geographical Statistical Section study all other matters of military value relating to foreign countries. The European powers are treated "exhaustively," and you know what exhaustively means when spoken by a German. Non-European nations, such as America and the British colonies, are treated in less detail, but all the principal facts concerning them are recorded. I have reason to know that attention has lately been paid to India. The section is also employed in correcting foreign maps and marking interesting details upon them. For this purpose it has a photographic establishment.

E and F.—*Topographical and Land Triangulation.*

These two sections are about to be amalgamated, as they carry out the same great work—the survey of the country—with special regard to military requirements. The Land Triangulation undertakes the most scientific part of the business, such as the cadastral survey. The Topographical Section works out the details and prepares the maps.

Being myself a gunner, I may perhaps be permitted to remark that the most scientific part of the survey is carried out by artillerymen,[1] who work under the guidance of the Great General Staff.

G.—*Intelligence Office.*

This remarkable institution was organized as a distinct permanent section of the General Staff in 1863, the year before the Danish War. All the information obtained by the other sections is handed over to it, systematically arranged and ready for use, so that it is, in peace, the one office which knows everything, and can answer all questions which Count Moltke may ask. It receives, besides, a considerable amount of secret intelligence even during peace. When we remember that service in the Army is universal in Prussia, and that a large proportion of the German merchants, clerks, and other employés working in other countries have been "one year volunteers," we cannot but be struck by the immense facility for gaining military information possessed by this highly organized and warlike nation.

At the outbreak of war, the principal Intelligence Office remains at Berlin, and uses all means of getting information. Officers, Police, the Diplomatic Corps, spies paid or otherwise, are employed, and money is freely spent for the one great end.

An Intelligence Office is also formed at the head-quarters of each Army and Corps, under the superintendence of the chief of the Staff, who details one of his Staff Officers for the special duty. These minor Intelligence Offices are all in communication with the chief office at Berlin, and thus any information, wherever reported, is, by means of the telegraph, made instantaneously useful to all.

H.—*The Map Room.*

In the Map Room are stored original surveys, and a quantity of maps for distribution. This section also registers all map work produced by the General Staff, and is in charge of the accounts and financial business generally.

Travels of Officers.

In the early part of each year the various chiefs of sections report to Count Moltke what points in the information under their respective charges require addition or elucidation. Acting on their reports, Count Moltke sends Officers to travel, giving them definite instructions as to the information required, and the day on which it must be furnished. All the reports find their way to the Intelligence Office.

The Staff Journeys, as they are called, form a great feature of the work. Under charge of Count Moltke, the Officers of the Great General Staff proceed once in the year to a particular district of the country where they act in all respects as the staff of an army engaged

[1] Oberfeurwerker. I should be sorry if any mistake were made as to the meaning of this passage. In most continental countries, as in Prussia, the survey of the country is directed by Staff Officers, and it is an axiom that all arms are to be fairly represented on the General Staff. The Artillery *as such* is always a fighting corps.—C. B. B. 26/2/75.

day after day. They have to make reconnaissances and reports, to design manœuvres, issue orders to imaginary corps and divisions, select quarters or bivouacs, and generally perform all duties of the Staff in the field.

The members of the Great General Staff are available for work in any of the sections, as are also the young Officers attached, after their course at the War Academy, or sent up by the Colonels. Thus, at a critical period of their lives, the aspirants for staff employment are brought in contact with the leading military spirits of their country, and with the great master of modern war. The work of these young Officers consists of preparation of memoirs on geographical or statistical subjects, solution of strategical and tactical problems, descriptions of foreign armies, and historical essays. In fact, the information already acquired is placed at their disposal, to be dealt with by them as Staff Officers would have to deal with it. The best papers are laid before Count Moltke by the chiefs of sections, and some of them are published in the "Militär Wochen Blatt." Publication is considered to be one of the special duties of the Staff, and arrangements for the purpose are made with military publishers at Berlin. Thus a constant stream of information flows from the Great General Staff to the Army and the country.

When war is declared, the main part of the Great General Staff joins the Army, the Officers being used to form the Royal Head-quarter Staff and the Staff of Armies. They are used, in fact, wherever their services are likely to be most useful. Half the *Neben Etat* remains at Berlin, and keeps the machine from rusting, but the chief work of the Department is over, because that for which it was preparing has come.

Such is the organization of the Prussian establishment corresponding with the newly-formed Intelligence Branch in England. We will now pass to the Austrian.

Austria.

The whole of the Austrian Staff, whether at head-quarters or with the troops in districts, is considered available for Intelligence work, and is employed upon it. But the staff in districts, like our own, has much routine work to do, and there is now a strong cry heard from them for relief from this burden. They ask that it may be transferred, as in the Prussian service, to a separate body of Adjutants. In fact, though the terms may differ, they desire to approach a system in some respects not unlike our own. The duties of their Adjutants would be closely similar to those of our Adjutant-General's Department, and their General Staff would then correspond with our Quartermaster-General's Department, especially since the latter has now an Intelligence Branch.

Time would fail us to describe the changes and experiments which have been made in the organization of the Austrian Staff since 1866. Suffice it to say, that the authorities leapt at one bound from that dangerous institution, a closed Staff whose Officers did no regimental duty and never commanded troops, to one in which the Staff had no advantage at all in promotion, but rose exactly as regimental Officers

rose. The whole scheme is now undergoing revision, and it is almost certain that the Prussian and English principle, of insisting that Staff Officers shall take a turn of regimental duty, will be adopted, and to this will be added, in order to draw the best Officers to the Staff, the further Prussian principle that Staff Officers shall gain considerably in promotion, so that they may have a greater chance of high command in the field.

The Austrian Department corresponding with the Prussian Great General Staff dates, in its present form, from 1871, and is thus organized:—

A. Directors' Division.
B. Military Description of the Empire.
C. Ditto ditto of Foreign Countries.
D. Railway, Telegraph, Post, and Steam-boat Division.
E. Military History Division.
F. Statistics of Foreign Armies.

In these divisions are employed 68 permanent Officers, besides clerks and Half-pay Officers, whom the Chief of the Staff has permission to employ, bringing their pay up to full pay for the time of their employment.

In addition to these strictly intelligence divisions, there are two staff departments, much of whose work is of special use for purposes of information. They are the *Military Archives*, divided into three sections. 1. The Archives. 2. The Library. 3. The Topographical Department, and *the Military Geographical Institute*, which is charged with the survey of the country and the production of maps.

If we were to include the Officers employed in these two departments, the total would be raised from 68 to 154, but we will omit them, because much of their work is for general military, and even civil purposes, only let us remember that the staff can always count upon them.

A.—*Directors' Division*

Conducts the correspondence, acts as a registry, deals with personal questions, and staff regulations. It has always a certain number of extra Officers attached to it, employed in reading and making remarks upon reports which have been sent in. The Director is thus enabled to decide upon the qualifications of Officers employed on reconnaissances or kindred work.

B.—*Military Description of the Empire.*
C.— *Ditto ditto of Foreign Countries.*

These two divisions may be taken together, because they are likely to be amalgamated, and because the character of their work is the same.

Hitherto, "The Empire" and "Foreign Countries" have been divided, for purposes of study, in two different manners. The Empire into seven "Fields of operation," Foreign countries (in Europe) into four "Theatres of War." The same, or almost the same, system has been pursued in arranging the information regarding them; and the

result is a mass of printed matter highly valuable, but difficult to fit together.

It is now in contemplation to amalgamate the two divisions, and to co-ordinate the "Fields of Operation" and "Theatres of War," so that home and foreign territory may be treated as one for military purposes. This seems a practical idea, for it is certain that, when war is declared, frontiers disappear from purely military calculations, and are replaced by natural features of country which may be either within or without the political confines of the State.

The Austrian military description of country is most elaborate, and contains all that can possibly be wanted for the most exhaustive studies. The form in which it is kept is valuable for the office or the barrack-room, but some Officers complain that the books are not strictly pocket-books, and could not conveniently be carried in the field.

The information required for war is brought together and arranged on two different but allied principles, and printed in octavo.

1st. General description of theatres of war, giving the peculiarities of countries, their topography, wealth, inhabitants, politics, and even languages; affording, in fact, all the information required for making great strategical decisions.

2nd. Description of the routes along which armies will probably march. These give all the information required by troops in movement, and are the results of the logistical studies of the Austrian Staff. Detailed reports on fortresses or strategical points are added, together with a topographical and statistical summary.

To gather this information, all available means must be used. For instance, in Austria all Government Departments receiving intelligence which bears on the military strength or resources of other nations are bound to send it at once to the Minister of War for the use of the Staff. Thus from one Minister, the Staff hears of the development of a mercantile marine, or the opening of a new port, from another, of the growth of some important industry.

Almost the whole of Europe has been thus studied, and the works are printed for use in time of war. There are distinct books for the two different "descriptions."

Corresponding with the books mentioned above are two sets of maps —Operation Maps and Route Maps.

The Operation Maps are produced by photographing the standard maps, and printing them very pale. This faint delineation of country is then worked over by hand, the useful features being accentuated and the rest left indistinct. They illustrate the first set of books.

The Road maps are prepared on a large scale, and then reduced. A small photographic copy is contained in each volume of the "Route Description" books. From these maps are removed all features not bearing upon the science of marches. Roads, railways, bridges, camping grounds, &c., are specially marked. *The roads all over Europe are divided into day's marches, each of which has a number, and*

corresponds with a certain page of the "Route Description," where is to be found, under the same number, a military description of the road and neighbouriug positions.

All the maps and descriptions are kept up to date—those referring to the Empire by the Staff of Generals in districts, those embracing foreign countries by the Head-quarters Staff, partly from material collected by the various "Divisions" of the Staff, partly from the reports of Officers who are constantly travelling to collect and verify information.

The 2nd and 3rd Divisions have published a number of works which take a high place among military standard literature.

D.—*Railway, Telegraph, Post and Steamboat Division.*

Precisely similar in the character of its work to the Prussian Railway Section but, as is shown by its title, its studies have a more extended scope.

E.—*Military History.*

Similar to the Prussian Historical Section. It has produced some works of the highest value for military students.

F.—*Statistics of Foreign Armies.*

This division has to collect and classify information relating to foreign armies, and further, to diffuse such information as widely as possible throughout the Austrian Army.

Newspapers and other periodicals are daily read through and marked, so as to call the attention of the other divisions and departments in the War Office, through which the papers circulate, to any paragraphs specially interesting to them.

Cuttings are made from the papers and pasted in books, together with manuscript notes from reports of Military Attachés, &c., on the same subjects. Thus, if the latest information on any subject of more than average interest is required, it is ready to hand at once. The work of this division is excellent.

Maps of foreign countries are kept with the territorial districts marked upon them, and states giving the actual strength of the armies kept up to date are attached to the maps.

From these states and from other information the division compiles a work,[1] the title of which may be translated as "Comparative estimate of the War Strength of European Powers, by Land and Sea." It is not confidential, and is sold in Vienna for about eighteenpence. Other works on foreign armies have been compiled in the division.

FRANCE.

France, the latest country which has had to confess the necessity for reorganising its military institutions, is bringing her staff system under review and making great and radical changes.

[1] "Vergleichende Darstellung der Wehrverhältnisse in Europa zu Land und zur See." 1874.

Up to 1869 the French Staff was a closed corps, fed by the Staff School. After leaving the school, the officers had to spend five years doing regimental duty with the different arms of the service; but when this service was completed, and they were actually appointed to the Staff, no further regimental duty was required from them. Hence arose an absence of knowledge of drills, discipline and interior economy, which was said to affect seriously the efficiency of the Etat Major. Colonel Stoffel speaks sarcastically of Staff Officers whose time had been so spent in clerical labour that they were unfit to appear before troops, and were even, sometimes, unable to ride!

In 1859, an Imperial Decree of 19th July, placed the competition for the Staff after, instead of before, entrance into the Staff School, and admitted to the hope of future Staff employment a number of officers in excess of those required to fill the Staff Corps. These extra officers were to be called "*Adjoints d'Etat Major*," to serve ordinarily with their regiments, and to be called to fill up the Staff in case of war.

This was a step towards throwing the Staff more open; but in the opinion of most of the best Officers in France, even of those now on the Staff, the measure did not go far enough.

Last month (January 1875), a final change was made. A new school called the "Superior War School" was instituted for Officers who have been some years in the service. But, as in Prussia, only the best pupils will receive commissions as Captains on the Staff. They are to do duty for two years with the arms other than that from which they originally came, then serve two years on the Staff in districts; and, finally, two years with the head-quarter Staff in Paris. Their promotion is afterwards to go in the Staff, but they must do regimental duty for a time in each grade.

Commanders of army corps and divisions will have, besides their regular Staff Officers, certain other assistants called *Officiers d'Ordonnance* who will, if I am not mistaken, perform the same duties as those of the Prussian Adjutants or our own Adjutant-General's Department.

This is as close an approach to the Prussian system as French national habits admit of. The principles are the same, but there is no slavish copy.

Let us now examine the organization of the French departments of the Staff at head-quarters charged with intelligence or information duties. They are specially interesting, as they are not older than our own Intelligence Branch.

A decree of the President of the French Republic, dated 12th March, 1874, organised the department of the Chief of the General Staff as follows:—

"The department of the Chief of the General Ministerial Staff "comprises the Ministerial Cabinet and Six Bureaux, namely:—

"1st Bureau. General organization and mobilization of the Army, "States and Effectives.

"2nd Bureau. Military Statistics: Historical Office.

" 3rd Bureau. Military Operations; Instruction of the Army; Topo-
" graphical Office.
" 4th Bureau. Etappen and Railway Service; Execution of Move-
" ments of Troops; Transport of Troops by Land
" or Sea.
" 5th Bureau. General Correspondence.
" 6th Bureau (or War Depôt).—Technical Services; Collections;
" Material and Accounts of the General Staff."

Since then experience has suggested several modifications.

The 5th Bureau has been absorbed by the 1st; the distribution of work has been rearranged; and certain changes have been made in the number and duties of the officers employed. Further changes may yet be made; but the present organization represents the result of French experience up to this time, combined with their study of foreign systems, and cannot but be interesting and useful to us who are advancing in the same direction.

All the bureaus are now working hard on exactly the same principles as those adopted at Berlin and Vienna. But their method of carrying out those principles is specially interesting to us because their work, like our own, is yet in its infancy. All arms are represented among the Officers in the bureaux, the same studies as those already described are being carried out and, in addition, they have to work earnestly and steadily upon the numerous arrangements involved in the reconstitution of an army upon new principles. Time and much labour are yet required, but we may be certain that, after her task is completed and the machine properly put together, the power of France for war will be tremendous. Talent has never been wanting to her Officers.

The present organization, which may and probably will be slightly modified when the new military system is in full work, may be set down as follows:—

A. 1st Bureau.	General Organization and Mobilization of the Army. States and Effectives. Distribution of Troops. Correspondence.
B. 2nd Bureau.	All information regarding foreign Armies and Navies.
C. 3rd Bureau.	Military Topography and Statistics. Preparation of Military Operations. Instruction of the Army as a whole—such as Regulations for Service in the Field, &c. Travels of Staff Officers. Grand Manœuvres. Historical.
D. 4th Bureau.	Study of Railways. Execution of Movements of Troops. Lines of Communication.
E. 5th Bureau (or War Depôt).	Drawing, engraving and altering Maps. Charge of Maps, Books, and Instruments.

Besides the Chief of the Staff and his aids, the number of Officers permanently employed amounts to 69. They are taken from all arms as well as from the Staff, in order to have specialists to deal with questions as they arise. But, besides the permanent establishments of

the Bureaux, Officers doing duty with their Corps throughout the country, whether on the Staff or not, are called upon to give their services in aid of the Staff studies at Head-quarters. For, indeed, the labour of seeking out the knowledge required is very great, and demands both much time and many hands. The work is being done for the safety of the country and no man can refuse his aid according to his powers. The adoption of this principle gives the Staff the assistance of an immense number of workers, whose labour is at once a benefit to France and an education for themselves.

1st Bureau

Is divided into three sections each under a Staff Officer:—

1st Section.—Organization of the active Army; its Distribution; General States; Effectives.
2nd Section.—Organization of the Territorial Army.
3rd Section.—Mobilization.

Little need be said of the work of this Bureau, though the importance of it is great at a moment when Organization and Mobilization are the most stirring military questions. But, consider the power and certainty such help as that of the talented Officers employed, gives to the military authorities during Parliamentary discussions. In fact, the law on the cadres has just now been settled by mutual agreement, although a severe conflict on the question was supposed to be impending, and everybody is satisfied. Is not this better than our plan of Royal Commissions and Parliamentary Committees succeeding each other in a weary series, the members approaching the subject with only one certainty,—that it is perfectly new to them and they must learn its rudiments?

2nd Bureau.

Foreign Armies and Navies.

Twenty-four Officers are employed in this Bureau alone, and the number is found insufficient.

The studies are precisely similar to those of the Prussian "Three Sections," and the Austrian Section for "Statistics of Foreign Armies." Great Powers are studied separately, small ones in groups. The studies comprise, military institutions, organization, instruction, men, material, establishments. Naval affairs are treated generally in less detail than the land services.

All this information must not only be in the possession of the Bureau, but must be so arranged and co-ordinated as to be at disposal for the immediate enlightenment of the Government or authorities interested.

Moreover, to the 2nd Bureau is confided the task of spreading such information as may be desirable among the Officers and men of the Army generally.

This duty is performed by periodical or special publications, such, for instance, as the "Revue Militaire de l'Etranger." The French Government and military authorities have accepted the truth that it is

not enough to have information accumulated at head-quarters, but that it is wise to diffuse a knowledge of foreign military systems as widely as possible. Every encouragement is given to officers to study such subjects, and to travel for the purpose.

This Bureau receives and deals with the reports of the military attachés, and is responsible for bringing any valuable information contained in them to the notice of the authorities specially interested in it. By this course every head of a department knows that nothing interesting will escape him, while he is not burdened with the task of reading a mass of MS. which does not concern him.

The military attachés of French embassies, like those of Prussia and Austria, report directly to the Minister of War or the Chief of the Staff. In any case the Staff receives and deals with the despatches at once. English military attachés report to the ambassadors. Their despatches go to the Foreign Office, and thence through many hands before they reach the Intelligence Branch. Is not this system rather unpractical?

Before the late war, and its remarkable lessons, the French system was highly unpractical. Not only Colonel Stoffel's despatches, but the reports of numerous Officers sent to travel in Germany, called attention in the strongest terms to the superiority of the German organization for war, and to the extraordinary development of the military art in the country of Frederick the Great. Nay more, the inferiority of the French system was frequently insisted on. The reports were received, docketed, and carefully pigeon-holed in the War Depôt, but, from the want of a department responsible for utilizing the information contained in them, those important documents were suffered to lie unread and unknown by the great officials in whose hands had been placed the safety and honour of the French nation.

The lesson has been a severe one, and the result is that at the present moment the chief anxiety is not to hide, but to diffuse information as widely as possible. Not only does the 2nd Bureau publish its papers, but Government money has been granted for the encouragement of the "Réunion des Officiers," an institution first established by private members, but now recognized as a means of bringing to the light of day, opinions, often crude enough, held by individuals concerning home or foreign military affairs. The publications of the Réunion are sometimes valuable to the authorities, always a safety valve for that intellectual energy so characteristic of the French. Thus a former source of bitterness and grumbling against authority has been turned into a well spring of information and contentment.

3rd Bureau.

This Bureau is at present one of the most important and active in France, though many of its functions are of a temporary character, and will cease when the epoch of change ceases, when the Army is fairly reorganized, and the studies which must precede modern campaigns are completed so far as only to need periodical revision.

It is divided into four sections—

1st Section.

Preparation of Military Operations.—Study of probable theatres of operations at home and abroad. Travels of the Staff Officers. Grand manœuvres.

2nd Section.

Instruction of the Army as a whole.—Questions relating to general instruction of the Army. Preparations of rules applicable to all arms —*e.g.*, regulations for service in the field.

3rd Section.

Study and Arrangement of Documents necessary for Armies taking the Field.—Such as maps, statistics, military topography.

4th Section.

Histories.—Assembly of historical documents relative to the last campaign. Study of these documents with the object of extracting useful information from them, especially the modifications which should be introduced into the tactics of the different arms.

Think for a moment what this Office has to do. No less than to plan the defence of the country and the best means of attacking other countries. The same studies are pursued by Prussia, Austria, and other Powers. Surely we had better keep our eyes open to this fact. Now, strategical studies such as these, must be based upon accurate and detailed knowledge, or they will not be worth the paper they are written upon. To gather the accurate details, all the army is at work. No less than 80 Officers of the garrison of Paris have been occupied in studying the surrounding country with a view to the thoroughly scientific defence of the place. Let me earnestly beg you to turn over in your minds this necessity for employing Officers outside any new Intelligence Department. Without such aid, facts must be wanting, and all calculations must be baseless and delusive. Whoever has good will and common sense can assist in some part of the work. Neither are great talents required nor high education, but the work in itself is full of interest and instruction.

Officers belonging to the 3rd Bureau attend Autumn Manœurves, and report on various interesting points for the information of their chief.

4TH BUREAU.

Railway Service and Movements of Troops. Lines of Communications.

Divided into two Sections.

1st Section, Railway Service.

Duties.—Work indicated by the "Superior Committee on Railways." (explained hereafter). Studies relative to the execution of this work. Relation with the railway companies.

2nd Section.

Execution of the Movements of Troops.—Sending the detailed orders required to carry out Ministerial decisions. Correspondence relative to all the movements of troops at home, and to or within Africa.

In November, 1872, a Committee was appointed to consider the whole question of railway transport and lines of communication. Its Report was adopted last July, and is now the basis for the work of the 4th Bureau. The scheme recommended and adopted is most interesting and instructive. The Report has been translated for the Intelligence Branch and would be published at once but for that terrible bugbear, the cost of printing.

There is no time to enter here into the details of the Report. Suffice it to say that all sorts of contingences in war and peace are provided for, even flying trains to be always kept packed full of provisions not far in the rear of operating armies.

The great principle is to combine the labours of Staff Officers who know what is wanted, with that of railway officials who know how best to supply the thing required.

France is divided into six great railway systems, each of which is placed under a Staff Officer who is called the "*Commissaire d'Etude*" for the line and its tributaries. Attached to him is a "superior agent," and the two form a committee with very definite duties and powers. They have to carry out the instructions contained in the Report, and they have legal power to do so. Provision is made for experiments and for practice of the troops. The Report can be bought in Paris, and is well worth reading, even by those whose duties are not likely to place them in charge of railways or lines of communication.

5th Bureau (*War Depôt*).

The War Depôt is chiefly concerned with the care of maps, books, and instruments, and with alterations to be made in the maps and statistics of the country.

It employs 16 Officers, 12 of whom are on the Staff, and a number of other employés.

General Remarks.

If we now look back for a moment on the ground we have passed over, we shall see that the strictly Intelligence Duties of the Staff in Prussia, Austria, and France are directed and performed by Staff Officers devoted to that particular work, aided by the whole of the Staff of corps, divisions, and brigades, and, in France, where the work has hitherto been more or less neglected, by all the available talent of the Army.

We see further a general agreement as to the facts which ought to be known, and the manner of getting at the information. The work required may be shortly stated as follows:—

1st. A thorough military acquaintance with the topography and re-

sources of all lands belonging to the nation and its neighbourhood.

2nd. An intimate acquaintance with the armies and military institutions of foreign powers as well of the home army and institutions.

3rd. A scheme for movement of troops by railway, road, or water, according to probable eventualities. This is based on a study of home and foreign means of communication.

4th. Military history, which is always a mine of information if honestly drawn up according to official knowledge.

5th. Selections from the above items of knowledge carefully drawn up and published for the information of the Army. This requires frequent use of the printing press.

6th. In the three countries the Staff is charged with the issue of the requisite maps in case of war; and, for this purpose, is in close intimacy with the great map-making establishments represented by our Ordnance Survey, which is a civil branch, though conducted by Officers of the Royal Engineers.

This kind of preparation for war is considered quite as necessary as the provision of arms or the drilling of men. It ensures the absence of delay and confusion—those sure fore-runners of defeat—at the beginning of a war, and enables the nation to make the best of its resources whether they are large or small. A military power neglecting these Staff duties in peace may as well put its neck under the feet of its enemies. A portion of the Staff must be set apart for intelligence duties during peace by any nation which does not desire to be utterly confounded when overtaken by war. But it now becomes necessary to anticipate an objection sure to be made by those persons whose minds are under the dominion of fashion. They will recognise the value of such studies for foreign nations, but deny that England has any need of them. Or they will say, as has been said to me more than once, that an Intelligence Branch of the Staff is only needful on the supposition that England is likely to enter into a Continental struggle.

Let us for a moment, and for the sake of argument, grant that we are no longer a Great European Power, that we have no duties which may force us to draw the sword for a principle involving our own general interest, and that our name as a nation may be effaced from the books wherein are reckoned up by the remaining Great Powers, the forces they may have to deal with if they declare war. At least there remain upon our hands certain territories, not so very limited in extent, called the British colonies.

The colonies spend upward of half a million annually on their militia or volunteers; and have, not counting India, about 70,000 men ready for fighting, to say nothing of the legal powers possessed by the Canadian Government of calling out all the able-bodied men in the country, about 740,000.

To this the objectors will reply—"Oh! but we don't want to keep the colonies. We should be stronger if they were cut loose from us, and we

should trade with them all the same." Now, Gentlemen, we soldiers have no business with politics. If an English Government should ever, in the name of Her Gracious Majesty, cast the colonies adrift, our business will be loyally and humbly to carry out the orders we may receive. But we have every right to state plainly the military arguments for retaining a footing where we have it, that is, wherever the sun shines. Let me state the argument in its skeleton form.

Such a trade as that of Great Britain is based upon the safety of our merchant ships.

The safety of merchant ships depends upon their protection by a fleet of war-ships.

War-ships depend upon coal, ammunition, and provisions, which are, none of them, found among the waves, but in depôts on shore.

Therefore the security of our world-wide trade obliges us to keep territory all over the world, for the supply of our Navy.

If this argument be of any value at all, it proves that no nation can, in modern times, keep the command of the sea without colonies, and, that command failing, England's fair palace of commerce would vanish like a dream before the first rude shock of war.

Whatever may be the ultimate fate of the colonies, there are no present signs of their leaving us; and, meanwhile, we surely ought to know something about them from a military point of view. We ought to study them at least generally, if not "exhaustively," as the Germans say. We are trying to do so now, and the attempt shows more plainly, day by day, how much we do not know and need to know. Yet, short as is the time since we began to work on the colonies, and few as are the workers, our labours have already borne some fruit. Foreseeing that Natal might become interesting from a military point of view, we prepared a *précis* of all information to be found in this country with regard to the colony Sir Garnet Wolseley has been suddenly ordered to go out to. Our *précis* was placed in the hands of the printers to-day, and when Sir Garnet starts on Monday next, he and each of the Officers of his staff will have in their hands an octavo volume of some 90 or 100 pages, containing systematized information on all the subjects likely to be valuable to him, from the history, geography, and statistics of the colony, down to such small details as the money, weights and measures in use, not forgetting the nature of the native races with whom he may possibly have to deal. Then our own home islands, Great Britain and Ireland, are by no means completely studied as yet, and all men will grant that we ought to be thoroughly informed as to the measures necessary for home defence.

The attitude of certain Englishmen, ultra-peaceable in talk, reminds me of that immortal member of the Society of Friends who once found himself on board a ship about to be attacked by an enemy. The Captain, needing every stout arm he could find, appealed to him to lend a hand in the defence. But no! "his principles would not allow him to fight." The enemy closed, and began to board. The Quaker shook his head, and, advancing to the bulwarks, pitched one of the assailments into the sea, exclaiming "Friend, thou hast no business here." I fancy that any nation which should aim at stripping England of

her colonial possessions, invading our soil, or taking from us the command of the sea, would soon hear from our most peaceable mouths "Friend, thou hast no business here."

But may we not go a step farther, and ask whether it is so absolutely certain that our swords will never again flash in the brighter rays of a continental sun? Never for the sake of conquest or from lust of territory. Such ideas are altogether dead in our minds. It is, however conceivable (to say the least of it), that we may be called upon to interfere in defence of a principle necessary to our national life. For after all, "Man doth not live by bread alone." A foreign writer has lately said, "scratch the British morality and you find a savage underneath." Let us rather say, "scratch the crust of British conventional talk and you find as bold and adventurous a spirit as ever moved our forefathers to the great deeds on the memory of which we feed our children."

Do you remember that the cry for perpetual peace was far stronger before the Crimean War than it is now? At that time public consent had gone so far that an ill-advised person could write a pamphlet proposing that, if England were invaded, we should receive our guests with open arms and win them by tenderness to offer us an indemnity instead of exacting one. Since then, we do not seem to have come much nearer the Millennium, and may fairly say—"scratch civilization and you find men and women with all their hopes and fears, pride and passion." But there is no need for argument. Mr. Disraeli in his place in the House of Commons, Mr. Gladstone in his late writings, and that great exponent of public educated opinion, the *Times*, have lately told us that England can no longer count on exemption from the common lot of mankind and of nations, a struggle for life, and, let me add, gentlemen—the survival of the fittest. Should such a struggle be forced upon us the country will turn to its soldiers and ask—"Are you ready?"

That time will not find us vieing with other nations in the ostentation of our armaments, but it ought to find us knowing at least exactly what we can or cannot do. An army of 100,000 British troops kept up as it might be from home, is a force by no means to be despised. In 1871 it would have raised the siege of Paris, or crushed Faidherbe or Chanzy according as we had taken one side or the other. Such an army must, however, be ready to act at any moment or half its value is gone. When the time for action comes it will be too late to commence our studies of the means of moving our force or keeping it in the field. All that should be done now, when such studies would be a menace to nobody, not hereafter when the undertaking would be one of the signs of "drifting into war."

There is another important reason for the formation of such a department of the staff. General Todleben remarks, in his book on the defence of Sebastopol, that England has in peace no proper "service of the Quartermaster-General," and he adds, "All this so important part of the military administration is only constituted at the very moment when the troops take the field; thus, much time passes before the staff of the army can be completely organized." The

criticism is just, and still applicable to us. We have our classes and examinations for the staff at the Staff College, and, having got our officers, we scarcely ever again set them to do real staff work till war comes. Were it only for this reason the staff organization which I have just described as existing in foreign countries, would be of equal value in our own.

Theoretically, such work has always formed a part of the duties of the Quartermaster-General's Department, but practically, the few officers he has, are absorbed in office duties, so that he has had none to spare for geographical, statistical, and historical studies, or for calculation of strategical and tactical probabilities, based upon a known system of moving troops in war.

It is a significant fact that the proportion of Staff Officers to regimental Officers in the English army is less than that existing in Prussia, Austria and France.

In Prussia the proportion is	2·06
Austria	2·06
France	2·36
England	1·85

This state of things exists because the public mind does not understand what is the proper employment of staff officers, and, therefore, cuts the staff down as closely as possible. The popular idea is that the staff have to carry messages in the field, and be agreeable to their partners at balls, instead of being as they should be, an Argus-eyed and Hydra-headed giant, ever providing the information on which a General must needs base his plans, and working out the details necessary to give effect to his orders.

Then there is that terrible word of power before which we all tremble,—the Estimates. Let us make a little estimate of our own. At this moment, it is estimated that Europe could put something like ten millions of men under arms. Everywhere arsenals and dockyards resound with the clang of hammers. We ourselves are driving a roaring trade in war ships and arms. It is impossible to believe that an English Parliament will grudge the trifling sum necessary to keep us informed of the position in which we stand, and of the means necessary to keep us secure. It would be as if a rich man of indifferent eyesight, knowing that he would shortly be placed in the presence of savage animals, should grudge the money to buy a pair of spectacles. Nor should we forget that the work to be done is not in proportion to the strength of an army, but to the extent of territory, the number of souls to be defended and the wealth to be secured.

Turn your eyes towards this table, and say whether we have much or little to do in comparison with other European nations.

In round numbers:—

Germany ..	has 212,000	square miles of territory	and	41,000,000	of people.
Austro-Hungary	„ 240,000	„	„	36,000,000	„
France with Colonies ..	„ 926,000	„	„	43,000,000	„
*Great Britain and Colonies	„ 5,400,000	„	„	290,000,000	„

* Not including the Hudson's Bay Territory.

To achieve the work necessary for the study of all this country, and the military statistics of this huge population, we have now, including the Topographical Branch,

7 Permanent Staff Officers,
4 Officers attached after course at Staff College.

Comparing like with like, permanent with permanent Officers, attached with attached, and remembering the world-wide interests of our country, it may be said that the English Intelligence Branch undertakes much more than the work of any General Staff, with a tenth of the number of Officers. If, then, there should happen a Colonial or European war, and complete information should not be forthcoming, let not the country be too severe on the seven Officers on whom this more than Herculean labour has been laid. I am not at liberty to say exactly what is being done. We are doing our best, and have no opponents that we know of.

Indeed, it is difficult to see whence opposition should spring. The essence of an Intelligence Department is, that it is in no sense executive. It robs no one of freedom or power; it must be the servant of all, ask for information from all, and be ready to supply information in return. It is a worker for Queen, Lords, Commons, civil and military departments of the State. It neither adds to nor takes away from the number of the standing army, though it may be said now-a-days, that if there are any individuals so far in rear of public opinion as to fear the small standing army of England, their voices are but the last faint echo of a far-off cry. The pursuit of information has not, like swollen armaments, any tendency to bring about war. An Intelligence Branch of the Staff has nothing to do with classes or politics, no business except to be ever on the watch to gain, to arrange and to distribute knowledge. To perform its work honestly, in other words, to be a real serviceable institution free from all suspicion of pretence, it must have more workers, and considerable freedom in the use of the printing press. While no confidence should ever be betrayed, there can be no possible objection to publishing in English what is published in all other languages. To lock up from English Officers information which is freely distributed to foreign armies, would be to put our own service at a dangerous disadvantage. And it seems to me that no harm could, and much good must, arise from direct personal and official communication between the Intelligence Branch and those great State Departments which have all to be consulted upon warlike measures, the Admiralty, the Colonial, the Foreign and the India Offices.

Up to this time there has never been a department of the kind definitely established in England; but alas! there has never been in the history of the world any such terrible activity and earnestness in military preparations as exist at present. A very small band of officers, called the Topographical Department, were hidden in a street not far from here working, as Englishmen will work, for duty, without hope of praise or renown. All honour to them, they did what was possible, and kept up the pursuit of information during the time

when the nation was most careless about military affairs. They now form a part of the seven permanent Officers shown upon that table as the existing means of work of the Intelligence Branch.

But now, everybody who has any information to give should help us through the first difficulties, as we shall be ready to help them in theirs. Let not the novelty of the idea turn the minds of the most conservative against us. The French ought to know something about the necessities of modern war by this time, and the verdict of their Committee on Army Reorganization is contained in these words of their report. "We were beaten by want of preparation, "organization, and direction, and by the weakness of our effective, "rather than by the arms of our enemies." That is to say, they had done just as some few people would persuade us to do now. They had lived in a blind confidence, and refused to recognise the altered conditions of modern war. France is indeed a great and glorious nation. She is rising like the Phœnix from her ashes, but we Englishmen are a sober people, and do not love catastrophes. Ours be the natural life of reality, not the immortality of fables and dreams. As all natural life exists by perpetual death and renewal of worn-out parts, so let us live as a nation; not trembling to move because every step consumes and kills some atom or other, but by vigorous exercise and cleanly habits, pass through the natural process of renewal and improvement while retaining the grand old individuality. Or, if there must be dreamers amongst us, let their visions be of a future when, united by common sympathies and common interests, as well as by blood, Great Britain and all her colonies shall join in a bond for self-protection; when free-born men, carrying arms as an honour, shall pace the shores of the islands and continents which own the gentle sway of our Gracious Queen, and at every moment of the twenty-four hours the sun shall somewhere look down on a sentinel who cries in the English tongue—"All is well in the Empire of Peace."

The CHAIRMAN: I presume that I shall be only expressing the feeling of this meeting, as I am only expressing my own feeling, if I assure the Lecturer that we have been extremely interested by the valuable information which is contained in the hour of conversational lecture which he has just given us. As he himself has observed, there was neither time nor opportunity for going into the details which were so essential to understand so great a subject thoroughly and efficiently. I, however, think it right just to point out—because to a certain extent, perhaps, it will be assumed that I have some responsibility in this matter—that the subject now brought to our notice is one that has been brought more especially before us of late years, since the great contests which we have seen carried on in various parts of the world, and because this country has always decidedly stood in this position, that it did not mean, on any occasion, to make any aggressive war, but that anything that happened would be accidental, and, to a great extent, unexpected. I must also point out that the estimates, though alluded to very cursorily, form a very large item in the every-day consideration of Englishmen, and that everything that is spent on the Army is always scanned with the greatest care and no very favourable eye. Under these circumstances it may be very easily understood that however desirable it may be largely to add to the General Staff of the Army for the purposes so very ably brought forward by Major Brackenbury, I must candidly state that it is not very easy to convince others that such is the case. I do hope the lecture we have heard this morning may tend very much in the direction of persuading others, as it certainly did not require to persuade me, that a great deal more

requires to be done in this respect. On the other hand, I think it only right, as occupying the chair on this occasion, to say that I for one, and most others who have attended to this subject, are perfectly alive to the necessity of the points that have been brought before us to-day, but that the difficulties we have to contend with have been hitherto so insuperable that nothing more has been effected than the appointment of the small number of Officers of which you have heard. I also wish to mention—and I hope the Lecturer will forgive me for so doing—(I have no doubt that in his place I should have referred to it) another matter, namely, that the survey in Prussia has been in the hands, very much, of Artillery Officers. I am very glad to hear that the Artillery Officers of Prussia have occupations of that description and time to attend to them, and not to Artillery work. I can only say, in this country, we have been in the habit of placing the survey in the hands of Engineers, and I am not aware that hitherto that survey has not been very well performed. As to the Artillery, I for one admire as much as any man in this country, our Artillery Service. I do not believe there is anything so perfect elsewhere; but they have such very important occupations to attend to, and such vast subjects of interest from day to day (now more than ever) come before them, that I should think that if these Artillery Officers, of whom we have heard, turned their minds to their own avocation they would be more usefully and more beneficially employed than in surveying a country which may very well be left to the very able hands in which it is placed in our country. I hope you will not suppose that I wish to give the slightest offensive meaning to the remark I have made, I merely wished, incidentally, to show that the cheer with which that observation was received might admit of being re-considered after hearing the observations I had to make upon it. I wish to state, most frankly, that, whilst I should be fully prepared to deal with many of the valuable subjects, and to entirely concur in the great bulk of the observations which have been made; there are, nevertheless, points which, if I had time, I might explain to this meeting in a somewhat different light. Of course it would not be either right, proper, or in good taste on my part, or possible, as regards time, to deal with these matters on the present occasion. I feel satisfied you will all wish, as I wish most cordially, to express our sense of the very able manner in which Major Brackenbury has brought this subject to our notice; and I state with the greatest pleasure, that there is not an Officer in the Intelligence Department which has just been established and is performing its work most efficiently—for example, in this little incident with reference to Natal—in whom the Army and myself have more confidence, than the Officer who has just given us this valuable lecture.

Evening Meeting.

Monday, February 22nd, 1874.

Colonel the Right Honourable Lord Waveney, F.R.S., A.D.C. to the Queen, Vice-President, in the Chair.

NAMES of MEMBERS who joined the Institution between the 16th and 22nd February, 1875.

LIFE.

Murray, C. Wyndham, Lieut. 61st Regiment.
Grey, H. R. E., Commander R.N.

ANNUAL.

French, J. D. P., Lieut. 19th Hussars.

THE "MACOMBER GUN."

By D. O. Macomber, C.E.

My Lord, Ladies, and Gentlemen, before reading my paper, which is a short one, will you permit me to make a remark or two in relation to my appearance here this evening? A few friends asked me to deliver a lecture; I consented to do so, and, by the kind courtesy of the Council of this Institution, I have been allowed to deliver that lecture here. I do not appear here this evening for the purpose of finding fault, or even criticising, the manner of any other kind of gun-building. I am only here to explain my method, and nothing more. If, therefore, there should be, as undoubtedly there may be, those present who have perhaps spent a lifetime in the study of gunnery, I beg leave to say I defer very much to the opinion of such experience as they must have. I have only spent about thirteen years in this matter.

The construction and use of cannon or large guns takes precedence, in point of time, of that of the use of small arms, by more than a century. The discovery of the art of manufacturing gunpowder, in the thirteenth century, changed the whole principle and practice of the art of war at once and for ever. The ability to reach an enemy at a long distance obviated the previous necessity of the meeting of armed bodies of men in close proximity with the weapons then in use.

The progress of civilization has materially changed the character of

offensive and defensive arms, but has not obviated the apparent necessity for their use. If self-defence be a law of nature, it is probably as applicable to nations as to individuals, and the *preparation* for this defence implies the adoption of the most powerful and effective means of resisting invasion by any nation, however reluctant that nation may be to commence hostilities against her neighbours.

Within the present century, the importance of *artillery* on land and *heavy ordnance* on the ocean has been steadily increasing; and that the fate of many of the great battles within that period has been decided by this arm cannot, I think, be denied. Within a comparatively short period of time, the adoption of iron-clad ships of war, by almost all the civilized nations of the world, has compelled anxious attention to the construction of heavy ordnance, capable of penetrating such armour; and as iron-clad ships must and do carry heavy guns, it becomes a question soon to be settled—can ordnance be constructed so powerful and safe as to pierce the heaviest armour a ship *can* carry, at a range which will ensure safety to the attacking ship? If we construct a gun which will throw a solid projectile of half-a-ton's weight, and at a range of 3,000 feet will penetrate a 16-inch armour, and this is the utmost power of the gun, what is to be done if we cannot approach within 6,000 feet of such an enemy? Weight of projectile is all important, but great *propulsive* force is absolutely necessary to render such projectile effective. *All force* in gunnery is, as yet, derived from the use of gunpowder. The more gunpowder we can burn and entirely consume behind a shot before that shot leaves the muzzle of the gun, all other things being equal, the greater will be the velocity and force of the shot.

In greatly increasing the quantity and strength of powder from the old standard, and in using the entire power of the gases generated, four conditions are necessary:—

First. To use the *strongest* gunpowder to be obtained, or that can be manufactured.

Second. That it should be of so *fine a grain* as to enable us to pack the greatest weight into the smallest space.

Third. To *so* ignite the charge as to burn the whole in the shortest space of time.

Fourth. To use a gun, so constructed as to be fully capable of sustaining *continuously* the strain of successive discharges, with perfect safety to the gun and gunners.

To give *reasons* for the adoption of these four conditions, I will briefly state, as to No. 1, the strongest gunpowder enables us to get the greatest *force* into the smallest compass, and also, if we use the strongest that *can* be manufactured to commence with, we are sure that no subsequent use of a *very* strong powder will or *can* endanger the safety of the gun. Strong gunpowder, for the above reasons, is also the most economical where great force is required. As to No. 2, *concentration* of power has the advantage over the diffusal of the same, as it enables us to confine our maximum power of resistance to a comparatively small space. After the inertia of the shot is overcome, the expansion of the gases in driving the projectile to the muzzle of the

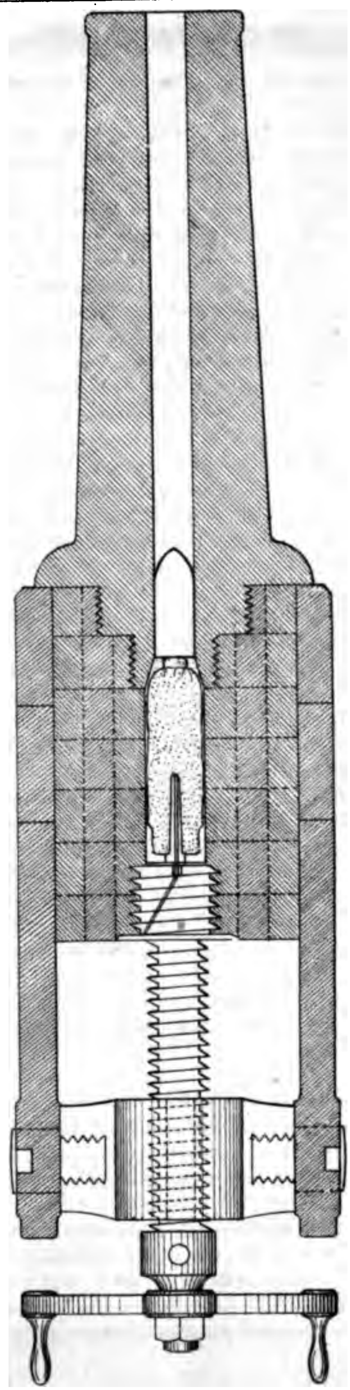
gun is in a constantly *lessening* degree, and, as a consequence, the "chase" of such a gun sustains comparatively less strain, and may be lighter and shorter than ordinary. As to No. 3.—The palpable reason for this condition is only an intensification of the two previous ones, viz., to shorten the space of time in which a given quantity of gunpowder might be entirely consumed. The perfection of this condition would be to use it in a perfectly spherical chamber, and force the point of the fire-tube into the centre of the same. Mechanically speaking, the nearest approach to this perfection of form is the oblong spherical shape of our enlarged powder-chamber, and the igniting the charge in its longitudinal and diametrical centre. As to No. 4.—This contains the gist of the whole system, and, as it will be fully explained further on, I will only say that, in my opinion, nothing short of *this* or some *similar* method of gun-building would *effectually* meet this requisition.

To subject each part *while* building to a greater strain than such part can ever subsequently be subjected to, by the use of gunpowder, is the basis of the power and safety of the Macomber gun, and forms *one* of the novel features of its construction.

For all heavy ordnance of modern construction, wrought-iron, steel, or cast-iron are used, the latter however, I am glad to say, but very rarely. With the increase of size and weight must be the *strength* of the gun. All metals have their limit of resisting force, and the *manner* of applying such force has, of course, much to do with the ability to resist it.

The discharge of gunpowder inside a gun or cylinder is tantamount to a blow given to the inner or under surface of an arch, and is of a very different character from a slow or gradual pressure applied to the same. Force is transmitted through all metals in an *appreciable* space of time. If I take six tin cylinders that are made to fit loosely one within another, and pass an iron punch through the inner one, I can strike several blows upon the punch before it begins to tighten in its place. Continuing these blows, the inner cylinder begins to tighten upon the next outer one, but I can still slip the third one off, and of course all *outside* of that. As the blows are repeated, No. 3 is rendered immovable. Soon No. 4 is in the same condition. No. 5 is fixed by a few strokes more, but still No. 6, the *outer* one, can be easily slipped off. Now, it is quite certain that, up to this point, No. 6 has taken no part in the resistance to my blows, which, however, I have been obliged gradually to increase in force, up to this time. I now have the united strength of five of these tubes or cylinders to resist the expanding force of my blows upon the inner one; but it is equally clear that *only* five have yet felt the force applied. Placing No. 6, the outer one, in its place, a few more heavy blows render that immovable. If I continue driving my tapering punch, I have the united resistance of the whole six to overcome. But how am I to *prove* that this is the case, and that the outer cylinder *does* now take its full share of resistance? Thus:—I continue driving, with still heavier blows, until the outer cylinder, No. 6, begins to expand, and until every blow I now strike

THE MACOMBER GUN.



J. Jobbins

upon the punch increases the diameter of the united set of six tubes or cylinders.

This rude experiment, and perhaps ruder description, is only an exemplification of the transmission of force through the body of metal surrounding the powder-chamber or cartridge of this or *any other gun*, and it is to enable me to overcome this unequal pressure between the inner and outer surface of the gun, that I use three different kinds of wrought-iron, in forming the entire breech of my gun. The amount of the inequality of this pressure is differently estimated by different writers upon the subject, some carrying it as high as eleven times, and some as low as four times greater on the inside than the outside, the ordinary tabulated strength of metals having little or no bearing upon the question. One of the most celebrated of the compilers of these useful tables in London, informed me that he was in possession of no reliable data by which he could give even an *opinion* on this particular subject. Fortunately, however, there is a very accurate method of overcoming this unequal strain, *whatever* may be the amount of it, and by the use of which, *all* the resisting power of the metal of a gun may be brought into practical use, at the instant it is wanted, by the sudden expansion of the gases in the instantaneous burning of quick gunpowder.

A blow struck by a steel hammer upon a metallic surface is as sudden in its effects upon the point of contact as would be the effect of the discharge of gunpowder, of the same *relative force*, upon the same surface. No gradual pressure of the same force can equal this concussion and instantaneous effect. The interior of the barrel or chamber of a gun is the under side of an arch, and the quick discharge of gunpowder *in* the chamber is a blow given on the weakest portion of that arch. As all gunpowder when ignited discharges its gases in every direction alike, we are thus certain that each square inch of the chamber in which it is contained will receive its exact proportion of the strain. By dividing the receptacle or chamber of the charge into transverse sections, we arrive at the maximum resistance which each section must bear. If we now subject each of these sections to a series of blows, much greater in force than will be the proportion which it will be called upon to bear when the burning of the charge takes place, we may, I think, safely trust to the resisting power of the gun. To *test* this resistance of the metal, various plans have been proposed.

Construction.

Evading all comments on the mode of building *other* guns, and coming to the method of constructing my own, I may be allowed to quote from one of the most practical and experienced English writers on this subject. He says—

"The material should possess hardness sufficient to resist the shock "of the projectiles; should be capable of resisting the chemical action "of the air, or of the compounds generated by the combustion of gun-"powder, and augmented in their destructive agency by the heat pro-"duced by ignition; should possess sufficient elasticity to resist a

"disruption of continuity, or a permanent change of condition, "resulting from the vibration produced either in rapid transport or "by frequent discharges; and also a tenacity sufficient to resist the "enormous pressure exercised by the elastic gases at the first moment "of their development."

The above requisitions seem to be fully confirmed by a titled author, with whose writings most of my audience are probably familiar, and who with less elaboration, but still stronger language, says—

"In the art of gun-making, the highest point to be attained is the "construction of a piece of such strength as to curb the utmost force "of whatever explosive compound can be used within it. The *beau* "*ideal* of a perfect gun, is one which will give the gunner the positive "mastery over gunpowder, in other words, a gun which *cannot* be "burst."

I know of no more comprehensive and correct definition than the above to the important question, what is required of the *most perfect* heavy ordnance which can be built? and in describing my own method, I have no wish or intention of condemning any other mode of gun-building, either in material or form of construction.

It is only by various opinions, methods and experiments, and different inventions, that progress can be made in this or in any other art. The only exception that I will allow myself to make is that I *do* not, and *cannot* believe in the use of *cast-iron* for heavy ordnance, and I attribute the high position now held by England in manufacturing heavy cannon, to her early breaking away from the use of that most brittle material for such purposes.

Equalizing the Strain.

Remembering the fact already stated, of the great difference in the strain, between the inner and outer surfaces of a heavy gun, at the instant of discharge, and the liability of a fracture to the former, before the latter has time to act as a re-inforce, I begin by overcoming this difference and entirely equalizing this strain, and bringing the whole resisting power of the breech to act at the instant of discharge. In calculating the force of a projectile, it is quite certain that it must be in proportion to the *amount* and *strength* of the gunpowder used; and all *other things* being equal, we cannot get a great amount of force from a small amount of powder. The quantity of gunpowder ordinarily used I believe in heavy guns (for of such alone I speak) is from *one-sixth* to *one-fourth* of the weight of the projectile, and in a few instances of moderate size calibre, of *one-third*, but usually *decreasing* the proportion with the *increase* of the weight of the projectile.

Determining first the weight of the solid shot, my practice is to use *one-half* this weight in the *strongest fine* gunpowder which can be procured. I then *know* that no subsequent use of gunpowder can exceed in force or power that which the gun has been constructed to bear. The *chamber* of the gun is proportioned in size to a capacity to hold without much compression this amount of fine powder. To form this chamber, and the breech of the gun (which is constructed separately

from the chase, and afterwards united with it by a very strong double screw), I make use of

Discs

of wrought-iron, and of my own invention, which have never been used for guns, or for any other purpose in this country up to the present time, and the peculiar construction of which was entirely new, until I patented the same. These discs are composed of three different qualities of wrought-iron, the softest forming the centre, and the hardest the outer circumference of the disc, and are thoroughly welded together, leaving a hole in the centre. After a sufficient number of these are prepared to form the gun, they are roughly engine-turned to bring them to a uniform thickness, and also to discover if any flaw or imperfection in the welding is to be found, and if there is, *that* disc is rejected and another substituted in its place. These discs are then submitted to a process of "setting" by steel punches (each disc separately) by powerful blows of the steam-hammer, beginning lightly and increasing gradually until the soft and hard metal has been forced (in a cold state) from centre to circumference to the point of enlargement of the latter, which *commencement* of enlargement is *proof* that every portion of the disc *will* bear its equal proportion of any future strain or concussion which it may be subjected to, and which, in the use of gunpowder, cannot exceed the test thus applied.

In Kert's "Treatise on Metallurgy," he lays it down as a rule, "that in wrought-iron, the *strength* will increase the more finely it is "drawn out." All of us know what immense strength and tenacity were to be found in the so-called "stub and twist" gun-barrels, which were forged out of old stubs and points of horse-nails. Some of the laminated steel barrels now in use are external limitations of the same.

After these discs are set, they are welded one at a time upon a mandrel by the process known to smiths as "jump welding," and as the centres of the flat of the discs are left a little raised, that portion unites first in welding, and thus presses *out* the scale, that might hinder the perfect union of the metal. Subsequently the mandril upon which the discs were forged, will be entirely taken out by the process of boring the gun, leaving only the metal which has been subjected to the steam-hammer and punch.

Steel Rings.

After the breech is finished, as above described, it is then accurately and smoothly engine-turned externally, and a proper number of steel rings *opened* and forged, without welding, so as not to break the continuity of the metal, are accurately fitted to the exterior of the breech, and are forced (without heat) over the same by a powerful hydraulic press, one at a time, and on one the "trunnions" are forged. For the gun before you, a power of 144,000 pounds was used.

If it should be deemed necessary in the construction of a *very* heavy gun to add a second series of rings over the first, it can be done with perfect ease, and great additional strength. For reasons previously

alluded to, the *chase* of this gun will require no supplementary steel rings, the strain upon it being *less* just in proportion as it is *greater* than ordinary on the breech. After the whole is finished, in accordance with the above, and the mechanical *setting* and strain have been duly applied during the construction, such a gun may be *worn out* in time, but it *cannot be burst with gunpowder*.

Setting of Metal.

To show that the *setting*, or enlargement of metal to obtain the full power of the outer portion of the same in gun-building, is correct in *principle*, allow me to quote from one of the most celebrated gun-builders and mechanical engineers of England, one who has certainly expended as much time and money in experiments of make and material as almost any man now living. He thus describes, in his own words, *his* mode of *proving* guns. "It consists in preventing the "shot from moving, when the powder is ignited, the gases generated "by the explosion escaping through the touch-hole. About one-sixth "of the regular powder charge fired in this way gives the same strain "to the gun as a full charge fired in the ordinary manner. To pre-"vent the movement of the shot, a screw is cut on the periphery of "the gun at the muzzle, and on it is fitted a screw cap, having a solid "end. The gun is loaded with a cartridge of the ordinary length, "but containing one-sixth of the regular charge, and supported by tin "discs in the centre of the bore; a flat-fronted shot with light wads "to prevent any escape of gas, and a round steel bar reaching from "the shot to the end of the bore are then introduced, and the cap "with the solid end screwed on.

"The gun is then ready for firing, after which my measuring "instrument is introduced into the bore, and any enlargement to the "10,000th of an inch in extent may be ascertained. If there be no "enlargement, the powder charge may be gradually increased, *until a* "*slight enlargement has been produced*. The strength of each gun is "thus positively ascertained, and this strength I would have recorded "and stamped upon each gun. This would give confidence to the "gunners, and would act as a check on those engaged in the manu-"facture. When the ultimate endurance of any particular kind of "gun is thus ascertained, the regular powder charge, or any less "quantity deemed advisable, may be used, the *enlargement* being "recorded after each discharge. A 9-pounder bore gun, made of my "metal, but reduced to 12 inches diameter, has been so tested, and "has had 18 full charges of $1\frac{1}{2}$ pounds fired from it. The expansion "*in* the bore is now ·1903 inches, and that of the *outside* diameter is "·0483 inches."

You will observe in the concluding part of this very accurate measurement of the enlargement of a gun by the force of gunpowder, that this enlargement by increasing charges, was, when completed, found to be nearly *four times* greater on the *inside* than on the *outside*, thus proving that the metal was compressed until the strain reached the outer circumference, thus equalizing in a degree the whole mass of metal, and *then*, and not *till* then, the experiment was deemed suc-

cessful, and the test firing suspended. Instead of finishing a gun, and *then* expanding it with gunpowder, I prefer to accomplish the same thing by mechanical means during the *construction* of the same.

Gas-check.

One of the greatest objections made to heavy breech-loading guns is the hitherto almost insuperable difficulty of *entirely* preventing the escape of gas at the breech. That I have, after many experiments and much labour, succeeded wholly in accomplishing this, those who have been present at the firing of this gun can testify.

The gas-check is formed or placed on the end of the breech-screw, and is made of solid steel staves, strong, thin, and elastic, and firmly bolted on to the screw, and in the form of a cylinder, enters the rear of the powder-chamber as the screw is driven in, and the chamber being slightly diminished towards the muzzle, these staves are *compressed* as they enter; and, being very closely fitted to the inner walls of the chamber, they enclose one half the length of the charge at its base, and being bevelled to a thin edge as they enter, they cut away all fouling of previous charges to the extent of their own length, and thus keep smooth the chamber against which they are pressed. When the discharge takes place, as about half of it is within this cylinder of staves, it presses them more firmly against the walls of the chamber and prevents any escape of gas between the two. As these staves are made in a number of separate sections, if one is found to have been injured, it can be removed in a few moments, and another always at hand substituted in its place. This method of forming the gas-check is cheap as well as effective.

Fire Tube.

This gun is loaded by placing the projectile into the rear of the rifled bore, then the bag of powder or cartridge into the powder-chamber. Two turns of a four-threaded screw close the rear tightly, and the gun is ready for the primer. I use Dyer and Son's friction primers which I now find well made and effectual. The primer drops into an orifice in the top of the closed screw close to the base of the breech. The fire is communicated to and *into* the charge by a fire-tube which enters its base, and is long enough to penetrate to the centre of the same. This tube may be steel, platina, or any other metal best calculated to resist the effect of the concussion. It is screwed into the end of the closing screw, and is of course surrounded by the staves of the gas-check, and if one is injured it can be instantly removed and another put in its place.

Force.

It will be seen by my description thus far that the object aimed at in the commencement has been kept steadily in view, viz., to burn the largest amount of the strongest gunpowder in the shortest space of time, and that the gun shall be able safely to resist the strain of such discharges for an indefinite length of time. The test of powder in this and all other guns must be judged of by its execution in *initial*

velocity, *penetration*, and *range*. And this naturally brings us to the recollection of a name justly honoured throughout the civilised world, a name at the very mention of which every Englishman's heart must warm with pride and gratitude, and I trust not less in America than in any other nation,—the name of Isaac Newton. He taught us the rudiments of those immutable laws of nature, by which all bodies in the universe are governed, and by which we know that on this globe a dense body falls sixteeen and a half feet (and a fraction) in its first second of descent towards the earth's centre.

To temporally overcome this law of gravitation we employ *force*, *power*, *energy*, whether of gunpowder or any other material to propel shot or shell on a plane parallel with, or above the surface of, the earth. *Force* or *power*, then, is what they want in war, and the greater the amount of this power used at a given moment, the longer will be the range and the deeper the penetration of a projectile, behind which this power is made to act. There is, perhaps, no more beautiful and interesting an experiment to a scientific and practical man, than testing the accuracy of the law of gravitation in the firing a cannon *levelled* by an instrument over a perfect plane, the gun being firmly fixed at an elevation of just 16½ feet above the surface, and then being able to find the exact point of contact of the shot with the surface of the plane. No "chronograph" would then be required to determine the velocity, as the flight of the shot, from the muzzle of the gun to its touching the surface, as well as the dropping of a like shot from the gun to the surface immediately under it, would exactly occupy the one second. The elevation of the muzzle of a gun to say 38 degrees for throwing shell, increases the strain upon the same, but a surplus of power and strength is held in reserve for such occasions by a gun of this kind, my aim being to apply the principle to heavy siege guns, and for penetrating ironclads with steel shot at a long range, *force* and *power* being the object. In the war of the elements, it is not in the roar of "Heaven's Artillery" that we fear destruction; but in the sharp silent flash of ignited electricity which *kills* long before the report can be heard by human ears, and which is never heard by the victim of its lightning power.

Powder, Loading, and Firing.

In the use of the best and surest means of obtaining the highest results of force in explosive material, I select the strongest powder and of a fine grain, that I may pack the greatest weight into the smallest compass. I would have no hesitation in using an amount of gun-cotton which would represent in force the gunpowder for which the gun is gauged. But I have not been able to procure the guaranteed force of a given weight of gun-cotton exploded in such a chamber as we use. Strong *gunpowder* I *have* found, and I am certain it *is* the *strongest* I have ever been able to obtain, either on the Continent or in America; and, that I may not be misunderstood in this essential particular, I take the liberty of giving a copy of the letter of Messrs. Curtis and Harvey, whose great kindness and courtesy to a stranger on that occasion I here desire to acknowledge and thank them for.

"*London*, *Jan.* 1875.

"D. O. MACOMBER, Esq.,

"10, Arundel Street, Strand.

"Dear Sir,

"In compliance with your request, we beg to state that an experi-
"ment took place in our factory at Hounslow on the 23rd of Decem-
"ber, 1874, with a gun represented to be your invention.

"The weight of the gun is 12 cwt., the calibre $1\frac{3}{4}$ inches. Two
"shots were fired, the charge of gunpowder being $1\frac{1}{2}$ lbs. of treble
"strong, No. 3 (our manufacture), and a conical shot weighing 3 lbs.
"Both were weighed by us.

"The first shot was fired to ascertain that the gun was properly
"laid. The second shot was fired in connection with Boulanger's
"chronograph; and, although this instrument was not arranged to
"record accurately over 1,500 feet per second, the actual velocity
"of the shot exceeded 2,000 feet per second, as far as we could
"estimate.

"We are,

"Yours faithfully,

(Signed) "CURTIS & HARVEY."

The process of loading a heavy gun of this kind, and of which this is but a "working model," is simple and rapid. Two gunners standing in the rear of the gun (by the breech of which they would be protected from the shot of an enemy in front), and one of them on each side of the loading screw can load and fire such a gun twice in a minute, if such rapid firing was at all desirable

After a discharge, and the gun is opened, they pass the shot through the powder-chamber into the base of the rifled chase, over a cushion fitted to protect the thread of the screw. The cushion is then withdrawn and the "charge" in a sack is quickly lifted to its place in the chamber. The closing nut and screw is turned one quarter round until it is stopped by the guard pin; both gunners then seize the crank, and two turns of the four-threaded screw drives the fire-tube into the centre of the charge, and the gun is loaded. One gunner now drops in the friction-tube, attaches the hook of the lanyard to the loop of the primer; both step back, and one pull discharges the gun. The screw is then turned back to its full extent, swung round, and the interior of the gun is open its whole length for air and inspection.

Perhaps it is needless for me to say that the shot being leaded to take the rifling of the bore, and in such a manner that the leading cannot "strip," all windage is prevented, and consequently there can be no "*erosion*" of the interior of the chase.

It seems to be too true that *war* was the normal condition of mankind in the earlier ages of the world. From that period to the present moment, the average sacrifice of human life in battle has irregularly, but steadily diminished. The reliance now, and for many years past, in the gage of battle seems to have been placed upon

artillery, and the fact that this arm of war has decided the fate of many of the prominent battles of the age, and has, in addition, greatly diminished the former loss of human life, might almost bring to its favourable consideration the venerable President of the National Peace Society.

When pitched battles come to be fought between modern armies with improved guns and at five miles apart, *suspension of hostilities*, *capitulation*, and peace may follow, but the loss of human life will be almost nil.

The CHAIRMAN: Mr. Macomber would add very much to the interest of the meeting if he would be kind enough to give a further explanation of the manufacture and application of the gun.

Mr. MACOMBER: I spoke first of the manner in which the chamber is built from discs. I have here a disc composed of three rings, the inner one rather soft, the next one a little harder, and the outer ring the hardest iron that could be used. When these are put together they are thoroughly and fairly welded into a disc, and then any defect can be seen, or if not visible then, the rough turning of the lathe gives to the surface a sufficient smoothness to show if there is the least defect in the welding of that disc. If there is, it is rejected of course: if there is not, it is ready for use. After a sufficient number have been thus made, we take a mandril and begin by welding one on to the other, "jump welding," which is hammering on the top and the side. This is done in the hot state, but only one at a time. If that is found to be perfect it is allowed to go on; if not it is replaced by another. Then another one is heated and welded on too.

Capt. SCOTT, R.N.: Are the lower two heated again?

Mr. MACOMBER: No, as little of heat as possible, for those that have been already welded. Then comes another and then another, forming the breech of the gun. Inside of this is the powder chamber, and you will bear in mind that all this material of the wrought iron is in the very best form to resist the pressure outward, and when this is all done then it is again put into the lathe and roughly turned to see if there be any imperfection in the welding of the discs together. This then forms the body of the gun. I have here a disc made as I have explained. A steel punch was introduced into this centre orifice and driven in with very powerful blows. The orifice was originally three-fourths of an inch in diameter, it is now $1\frac{1}{4}$ inches. What has become of the material? It has been driven out; the last punch was driven with a powerful 12 lb. sledge-hammer swung by a very powerful smith, a full blow, and at last the circumference began to enlarge. With an instrument ready we ascertained that we were beginning to enlarge the disc, and at the last blow struck upon it, it expanded the $\frac{1}{100}$th part of an inch. This is merely to demonstrate the fact that the outer side, if you go on punching, will continue to expand. You get, therefore, the whole power of the iron, and that is just all there is in that part of the disc system which I claim, will resist. Suppose this was two or three inches, of course the punch would be in accordance with the size of the gun to be used, and as I said before, every blow struck upon it, is like a discharge of powder on the inside, that is to say, it is as quick in contact as it would be, if it received that proportion of powder. After a sufficient number of these are made to form the breech, then they are made into the required shape. This is the breech of the gun, manufactured entirely separate from the other parts. These discs form the breech of the gun, and over the powder chamber particularly they are welded together to form what you see there. The chase of the gun does not require any steel rings on the outside, because the greatest portion of the force of the discharge passing through the breech, the comparative force through the chase is much less than ordinarily. The powder is entirely burnt before the shot reaches the muzzle. To prove that, I fired the gun over a lake twelve miles long and two miles wide, frozen solid, with a very fine and beautiful coat of snow upon the ice. It thus gave me the opportunity of testing that beautiful principle that I alluded to, and also of ascertaining that not one particle of the powder fell upon the snow unburnt,

which was the object I had in view. I will now show you the steel rings. These rings are not welded but opened and continued. These are forced on to their places by a power that is sufficient to press them down. If it is a large gun, it requires a very powerful hydraulic press; as I said before, the one we used in making that gun was 144,000 lbs., and there are four of those rings forming that breech. These rings are put on one at a time and forced on. In this case there is no heat used, that is to say they are not put on by contraction while the metal is cooling. After this is made, the whole is put together by a double screw, enabling us to build these guns in parts at different places and with the most perfect mechanical accuracy. The breech screw is a four-threaded screw, and two turns load the gun. Now in case of disruption what is to be the result? All this strength must be torn out from the rear; the screw must be torn away; the solid nut must be torn away before there can be any explosive force that could injure that gun at the breech. I fired a similar gun to the one now before you, no less than 280 times, and when I left it in France (I do not know what became of it after that, I believe the Germans got it), it was as perfect as when it left the machine shop. I have here specimens of the shot that we use, showing how they are leaded. The lead is held on by half holes drilled in the shot itself, and I have never known one of them "strip." The shot itself is leaded to take the rifling, and is kept in a straight direction by being held firmly by the base. If it were a longer shot, of course it would have a longer leading and a deeper groove. A shell to be thrown by a gun built in this manner, of course would not be quite so heavy as the solid shot. I have one here of precisely the form and style in which we used them when we were practising for range on Fire Island beach, off Long Island. The sabot falls off within a few hundred yards of the muzzle of the gun. This portion is filled with the lead which takes the rifling. When the elevation was 38°, that was sufficient to support it, while at the same time the shot was smaller somewhat and more pointed, and after this had dropped off, the shot attained a range of 9¼ miles measured with Gunter's chain.

Captain Kerr: Was not that gun tried on board the "Excellent?" and will you kindly state what took place there?

Mr. Macomber: The gun was, by the consent of the authorities, taken to the "Excellent" at Portsmouth, and thence on board the "Netley," and, under the superintendenee of Captain Boyes, was fired for penetration only. The distance, however, was only about 30 feet from the muzzle. The targets were 14 inches thick and had been used for heavy guns that were fired in position there. I told the Captain that my shot for that short distance would not strike point on, and it did not; for I will mention what is probably known to most artillerymen, that a rapid shot thrown from a gun of this kind, whether a small or a large one, has three motions instead of two: there is of course one forward, and one other upon its own axis, and besides that, in shots from this gun and from those that have a very high velocity, the shots have when they leave the muzzle of the gun a screw motion, but, in a short distance, they settle down and then go straight on. In testing this gun at Vincennes, at 120 yards, I was obliged to move it back 170, because the shot struck sideways, they had not settled. Moving it back, however, to 170 yards, the shot got point on and penetrated three inches of iron backed up by some 12 or 14 inches of oak. There was no instrument on board the "Excellent" to measure initial velocity. Subsequently the gun was fired at Fort Cumberland, and there was no instrument there for that purpose. I have not been able to find a place for testing initial velocity.

Captain Kerr: You say it was 2,000 feet?

Mr. Macomber: Something over 2,000 feet, as estimated by Messrs. Curtis and Harvey.

Mr. John Macintosh: Is the punching of those discs done in a cold state? and is there any crystallisation?

Mr. Macomber: Always cold. We never have had it; it was examined very closely with that view.

Mr. Macintosh: It seems to me the most vital point, universally considered by artillerists, that the powder gas strikes with a blow of about 40 tons to the inch, and that a repetition of these blows crystallises the metal, and deteriorates

the gun. You commence by striking the iron perfectly cold, and do mechanically what is done chemically by the powder; it is of great importance that the doubts of mechanicians on such a theory should be promptly dealt with, especially as to the causes of that enormous resistance you speak of. I think it is generally considered by mechanicians that striking iron with such enormous force as you speak of, will crystallise the metal. Now, if you can obtain a range of nine miles and a quarter by your gun, and by the perfect combustion of strong powder, it is one of the most important subjects that can possibly be conceived. With such a range as you speak of, that gun placed in a vessel of great speed (which is an element of success in naval warfare), could be used for firing incendiary shells into harbours, towns, and among shipping, at a range at which an ironclad would be useless. These are matters of the greatest importance, and ought to be discussed, and if you have succeeded in accomplishing your object, I must confess that it is beyond doubt the greatest improvement I have ever heard of in gunnery.

Mr. Vavaseur: Will Mr. Macomber kindly state what is the weight of his gun, the weight of the charge and the weight of the projectile, because from what he said I believe the performance of his gun has been exceeded, as far, at all events, as range is concerned, and I think as far as velocity is concerned. The gun I refer to is a breech-loader weighing 9 cwt., with a 3-inch bore; the projectile weighs 10 lbs., and the velocity is 1,968 feet.

Captain Kerr: Where measured?

Mr. Vavaseur: At Calais.

Captain Kerr: What was the charge?

Mr. Vavaseur: 3 lb. 3 oz.

Captain Kerr: Mr. Macomber has stated that his gun would take a charge half the weight of any projectile he can apply.

Mr. Vavaseur: But the question is what is the amount of velocity?

Captain Kerr: He said it had been tested up to 2,000 feet.

Captain McEvoy: I should like to ask the way in which the gas check is arranged; and also whether this gun is not the same as a gun exhibited in Paris under the name of the Ferris gun.

Lieutenant Bower, R.N.: Mr. Macomber has drawn attention to the performance of the gun, but there are one or two points I should be glad if he will explain to us. What would be the effect of a shot striking at the end of its journey? The shot seems a very small one as compared to the size of the gun, which is 12 cwt. Our 20-pounder Armstrong weighs 13 cwt., only 1 cwt. more. I understand that this gun is not to be used in the field where shell-power is all important. But if it is placed on board a wooden ship, shell power is of even more importance than actual range. Our present shells are very effective up to 2,000 yards; and beyond that distance, considering that you never have a steady platform at sea, it would be extremely unlikely that you would hit your enemy; ships that mean fighting will come within that distance. Shell power, therefore, is of the greatest importance, and the size of the shell and the effects it produces on arriving, are of even more importance than the actual range and penetration, especially against wooden ships. In the case of ironclads, where the shell would not penetrate and this shot would, I admit there would be a manifest advantage for this gun, but our present guns can penetrate the majority of the ironclads at present afloat in European waters, and if our shell did penetrate the broadside of any ironclad, the difference of the effect after arriving inside, as compared to the shell of one of these guns, would be very marked. The effect would not be confined to the mere explosion of the shell, but the effect of the explosion of a large charge of powder in a close battery would be sufficient to stun and choke nearly every man in the battery, and to place them *hors de combat* for the remainder of the action. I should like Mr. Macomber to give some more particulars as to the effect and striking force of his shot and shell.

Mr. Nursey: Mr. Macomber having recommended this gun for heavy siege artillery, has he gone into calculations as to what would be the weight and dimension of, say, a 12- or 15-inch gun? Perhaps he can favour us with some approximate idea.

Captain R. A. E. Scott, R.N.: I think I am right in looking upon this gun as

merely a working model; and of course, whenever one commences a series of experiments, it should be with a thoroughly strong gun. I do not think we can in fairness ask Mr. Macomber how much lighter he could make a gun on his principle, for that, after all, is a practical question. This problem has been worked out in England so far that we know what weights are necessary for our present description of guns. Nor do I quite agree with some of the remarks made as to the size of the shell of Mr. Macomber's gun, because you can easily lengthen the shell. The thing Mr. Macomber brings prominently before us is his method of building guns. I cannot agree with previous speakers, as to the effects of heavy charges of gun-powder; for I have never seen any damage done to the powder-chamber itself; the damage is always done where the gas rushes past the shell, or re-acts against the bottom of the bore, but if the windage be perfectly closed, there will be no damage done to the chamber. The erosion in the bore of our own guns is occasioned by the escape of gas over the shot. With studded projectiles and the large rifle grooves in which the studs work, there is a considerable escape of gas, and it is exceedingly difficult to prevent this, as the studs in no way fill the grooves. The consequence is, that our guns are very short lived. No doubt that the erratic movement of the shot in the bore greatly tends to destroy the gun. I think Mr. Macomber fails in the method of rifling, nor can I agree at all with what he says as to great velocities *necessitating* the point of the shots circling round (like an unsteady peg-top) out of its true path on leaving the gun. The fact is that the shot does not leave the gun properly centred, which is due to its rotation being imparted by the lead on its base. This lead is of larger diameter than the rest of the shot, and, therefore, the point of the shot drops in the bore of the gun and takes a circling movement on leaving it; and, therefore, does not fly straight until after some time. I cannot look upon this as detracting from the principle of building the gun or the principle of closing the breech; and although something has been said about shell power, &c., there is no doubt but that in an action at sea, you want the very highest velocity with the flattest trajectory possible. Unless given a very high velocity, projectiles will not penetrate on striking at acute angles. When we speak of our own shot penetrating certain thicknesses of iron, we merely mean when such are struck at right angles. This is, however, the exception in a naval action, and I fear we shall find that our shells will not usually penetrate. The courses of experiments have been made with firing at right angles; and we, therefore, do not really know the strength or penetrative power of our shells, so that their effect is mere speculation. I think we ought to be very much obliged to Mr. Macomber; and, as a member of this Institution, I feel great pleasure in thinking that here any gentleman can come and state his views openly and meet with the support that they merit. Although I may not agree with the details of Mr. Macomber's plan, I certainly do think that its merits entitle it to be very carefully considered. At the present time our own guns are short lived, give a low velocity, have small endurance, and the projectiles are, in my opinion, wholly unreliable.

Mr. Macomber: I have great pleasure in replying as far as I can to the enquiries made. It is for that reason I have come here, and I, therefore, am more pleased even with the objections raised, than I should be with a tacit consent to everything that I had stated. Captain Kerr asked questions with regard to the velocity of the shot, and also as to the discs, their power of resistance and so forth. Some portion of this will become so entirely *apropos* when I show the gun itself and its operation, that I will pass it for the present, and will answer the gentleman who asked in what respect this gun differs from the Ferris gun, shown at the Exposition in 1867. That was my gun; I built it, and for thirteen years, with that man at my right hand, I worked at it, and it is that gun that I should have been happy to have shown here, but unfortunately, when the war broke out, that gun was at Vincennes, I then being in negotiation with the French Government to purchase it, and all the preliminaries having been settled except the details, and where the large gun was to be built. The gun was at Vincennes, subject to my order, and I remained until about the last thing, and then came away glad to get out of the city without any gun. When the war was over I went back and that gun was not to be discovered. I had previously brought away the gas check and the end of the screw, and that is a part

of this gun, which shows, of course, it must have been exactly the same size. I made some improvements and patented this gun in England myself, but the Ferris gun was virtually the same thing. I built it, but whether he or myself was the original inventor I will not undertake to say. He is a gun-maker of extraordinary celebrity at home and he came to me and we worked together.

With regard to the velocity, I would simply say that experience brought me to this conclusion:—I found in all cases where the target was within say 100 or 50 yards as the minimum, the shot invariably struck at an angle. When firing the gun at Vincennes, I used a long blunt-pointed shot. The first shot I fired at 100 yards, struck sideways on the target, which was 3 inches thick with a backing of 14 inches of oak, and absolutely bounded back to within a foot of where I was standing. I then had the gun moved backwards until I had a full 150 yards, and the next shot penetrated 3 inches of solid wrought iron. In relation to the erosion I can only say that there is no windage in this gun. I do not say what it would be with a larger gun, I only say that is the largest gun I have ever built, but the lead fully and thoroughly filling the grooves and the lands, there can be no windage at all, consequently there can be no erosion.

As regards the blow that is struck, you will bear in mind that gun before you is made with 13 rings from one end to the other of the breech. They cannot, therefore, be very thick, and I maintain that the blow struck with that 3-ton hammer was greater than that portion of the chamber will ever receive as the maximum of its resisting power, and that no pressure exerted by the discharge of the largest amount of powder that could be used in the gun, would be so powerful as that to which these very discs have already been subjected. Another thing that should be borne in mind, is the facility given for constructing the gun in different parts. I can build the breech separately without the incumbrance of the chase, and as it is here where the great strain takes place, so also it is here where the metal offers the greatest resistance. I can only speak from experience in a matter of this kind, and as I said before, I fired the fellow to that gun 280 times, and it was as perfect when I last saw it, as it was when it left the hands of the builders.

In relation to the strength of the powder, I take it for granted that all guns must necessarily be strained in proportion to the amount of strength of gunpowder that you use. If I use the strongest and the largest quantity, then I do not know how that can be exceeded. The original of this gun was intended to be bored out to make a 6-pounder. The chase is just that much smaller than it would be if it was as it was intended to be, for a six-pound shot instead of a three. The gun was applied for for the Japanese Government at one time, and it probably would have been sent there if I had found the gun and had returned to the United States.

The Chairman: We have now been discussing at some length the *rationale* and construction of this gun, which is the main point we have to consider. We all know the short life of our heavy guns in consequence of the destruction of the bore by combustion of the powder. That is the thing against which I believe Mr. Macomber has striven, and it appears to me he has striven against it very successfully indeed. In this gun I find traces of genius which are unmistakeable, I call that an unmistakeable result of genius, which is equally fitted for the particular purpose for which it was originally intended, whatever the circumstances of size, of proportion, of use, or of action may be. Speaking of our guns of the old school, which suffered so much from the combustion of large quantities of powder, there was evidently some variable quality difficult to obtain, which would be represented, as I apprehend, by the tenacity of surface in that portion of the bore exposed to combustion, and which should be equivalent to the largest force disengaged by combustion of the charge, that is to say, probably latent power of resistance to an increased charge: that is the tenacity of material should be as the square of the additional charge of powder. A 20-pounder gun would, therefore, require less tenacity of chamber or bore to resist the disruptive forces of the charge, than a much larger one. That was the difficulty, and it has been got over, to a certain extent, by the employment of pebble powder.

I find in this gun a particular process adopted by which the power of resistance is taken to be the equivalent to the largest possible disruptive force acting within the bore itself; and it naturally occurred to me, not knowing precisely the principle

upon which this material was put together, that, as the size of the bore increased, and consequently force of combustion, the material, if it was merely in a crystallised state, as has been remarked, would in the larger class of guns require a greater power of resistance than could be obtained by ordinary means. But, according to the principle of Mr. Macomber, the force which forms the chamber, is itself always increasing in proportion to the necessity of its exertion, that is to say, that the larger steam-hammer gives a closer and greater density to the rings on which it is exerted, than the disruptive force of the larger charge of powder can overtake. That I take to show the genius of this discovery, because it matters not whether the gun be constructed to throw a 500 lb. shot, or the small shot that we have seen, in regard to its power of resistance. For as that force of the steam-hammer and punch, which has given the capacity for resisting explosive action in the smaller chamber, is proportionally powerful in regard to the larger chamber, therefore a gun of whatever size, if it can be fabricated at all by such machinery, must possess such a power of resistance to the charge, proportional to the bore, as has been obtained in the small gun.

Mr. Macomber (after removing the breech of the gun, and explaining its construction) said: A sheet of white paper was laid on the rear when the gun was fired on board the "Leopard," and there was no discoloration, no escape of gas.

The Chairman: I think I understood you to say, the combustion was perfect, and that no grains of powder were left on the snow?

Mr. Macomber: Not a particle. The white snow on the frozen surface of the lake enabled us to see if there was a single particle, for the nitre and charcoal would be discovered at once as it fell upon the white snow. That enabled us to determine clearly that the entire charge was burnt before it left the muzzle of the gun.

Captain Burgess: Was it on the lake you got that range of nine miles?

Mr. Macomber: No, it was afterwards, on Fire Island Beach, which is said to be the only place in our country where such a range can be obtained, and the shot found. As I said, measured by Gunter's chain, which I purchased for that purpose, the range was 9¼ miles. I, with reluctance, mentioned that for this reason: I think I ought to confine myself entirely to the experiments and trials that should be given to this gun in this country; but I am ready, and should be most happy, to have an opportunity of testing the range in that way. I am told by the best artillerymen here, that if I get the initial velocity settled, they can calculate the range at an elevation of say 38°; of course the range is regulated by the force of the powder, and I do not hesitate to say, that every opportunity that I have had I have embraced for the purpose of testing range. I could find none satisfactory in or near Paris.

Captain Scott, R.N.: With a charge half the weight of the shot, there is not the slightest doubt you must get a velocity of over 2,000 feet a second.

Mr. Macintosh: In reference to the perfect combustion of the powder, your test was over a horizontal plain, and the unburnt particles were presumed to gravitate on to the white sheet. Now I have found in using strong fine powder that it is blown into the air to a great extent unconsumed. If you had a sheet held perpendicularly, and one placed horizontally on the ground, at a certain distance from the muzzle, it would obstruct the powder, and I have no doubt abundant particles would be found on the horizontal sheet. I suggest that it is an element of the utmost importance to use the greatest quantity of strong powder in an enlarged chamber, and thus to get perfect combustion.[1]

Mr. Macomber: You will see at once by looking at the gun, that the fire-tube penetrates the charge to the centre, and when combustion takes place, it has only to burn half of it, because the other half burns equally the same, and, therefore,

[1] I would remark that the range could be easily obtained by putting the gun on a steam-tug, and going to a suitable place, anchoring the tug and a boat nine miles apart, and then firing one of my incendiary shells, which, when it drops into the the water, ignites, and causes a thick volume of black smoke to arise, and this would accurately indicate the range. I volunteered to pay the cost of the experiment some months ago, and will cheerfully do the same now.—J. M.

if the charge was double the length, we should, of course, have double the time. We know that the powder, if ignited at the end, would be twice as long burning as when lighted in the centre. I therefore take advantage, as far as it is possible, of the shape of the chamber, to ignite it in the shortest space of time. My friend, Mr. Macintosh, alludes to the compression of the charge. I do not intend to press it hard at all into a bag, but it contains easily the amount of powder that I use. With a shot of 3 lbs., the powder will be 1¼ lbs. I know of no quicker way, unless the chamber were entirely globular, which, of course, could not be mechanically fitted into any gun.

The CHAIRMAN: I think I shall interpret your wishes if I thank Mr. Macomber for the exceedingly interesting information he has given us with regard to this very remarkable invention. I must certainly express my great admiration of it, and the way in which he has brought it before us. I think I may say also, that we desire that he should have every facility given him in this country for making known to the public the very ingenious arm that he has added to our implements of warfare.

LECTURE.

Friday, February 26, 1875.

MAJOR-GENERAL SIR H. DRURY HARNESS, K.C.B., R.E.,
in the Chair.

A WARNING VOICE FROM THE SPANISH ARMADA.

By Major-General T. B. COLLINSON, R.E.

Attend, all ye who list to hear our noble England's praise;
I sing of the thrice famous deeds she wrought in ancient days,
When that great fleet, invincible, against her bore in vain,
The richest spoils of Mexico, the stoutest hearts of Spain.
—*Macaulay.*

INTRODUCTION.

"Before one talks of military affairs he must first of all be skilled in naval tactics."

UPON a tablet in a public garden at Nan Changfu (the capital of Kiang-se), the above is recorded as a remarkable saying of Change-king, who was a General in the time of the Sung dynasty.

If this maxim was considered worthy of such record in a continental empire like China, it should be of greater value in a maritime empire like Great Britain. If it signifies that the general organisation of a force at sea for battle, should form the foundation of that of a force on land, then I think it is a maxim peculiarly applicable to this country; and that the story of the Spanish Armada, of 1588, is a decided illustration of its truth.

The commonly received idea of the defeat of that Armada is that it was mainly the work of the storms of Heaven; but those who read the accounts of it in Froude, in Mottley, and in the original documents of the time, will, I think, come to the conclusion, that although the complete destruction was caused by extraordinary tempests, yet the failure had occurred before they began, and that was due partly to the inherent defects in the Armada itself, but chiefly to the skill and spirit of the English Navy. And from the proceedings of both the contending parties, from the successful and the defective measures on both sides, I draw the same lessons, which even at this distance of time, are, it seems to me, of value, in considering the subject of the general defence of these islands; and which will, I think, give a pregnant meaning to the maxim of the Chinese General. It appears to me that:

There are three Lessons to be learnt from the Armada.

1*st. Decentralisation.*—That is to say that as much liberty of action both in carrying out the details of preparation, and in the actual war-

fare, should be given to the local Commanders, as is possibly compatible with the control and supervision of the central authority.

2nd. The preservation of the Martial Discipline of the Country.—That is to say, that the defence of these islands shall be made to be felt such a national duty, that there shall always be ensured a sufficient proportion of the able population, to some extent armed, trained, and disciplined. And—

3rd. An abundant supply of efficient Seamen.—That is to say, that not only should there be effective seamen enough in the Navy and its immediate reserves, but that measures should be taken by the Government to preserve as far as a Government can, a race of thorough sailors in our seafaring population.

It may be said by some objectors, that one need not go back to the times of the Spanish Armada to learn that those three points are important to the defence of this country. And by others, that the days of danger to this country from great Armadas are gone bye, never to return; and therefore that the ideas of those days are no longer applicable.

I should be very glad indeed were it unnecessary for any person to appear in this Institution to call attention to the importance of those or any points connected with the defence of the country; but when one sees that, notwithstanding the vast sums expended on our Army and Navy, economy and not efficiency has been the guiding rule; and that any organisation of the population of the country towards its defence by land or by sea, has been looked upon as an obsolete idea of a passed epoch, one cannot think that these points have been as yet felt by the Government and the country to be of that importance. And hence, I hope, it will be not altogether a superfluous or useless undertaking, to draw attention to a remarkable illustration of their value, in one of the most vital exigencies of our national history.

Those objectors, who think that the probability of a great national struggle is a chimæra existing only in the brains of retired Admirals and Generals, I request to compare the present state of Europe with that immediately preceding the Armada. Then two or three powerful nations had been fighting for some years for rectification of boundary lines; large Armies and Fleets, armed with newly invented cannon and firearms, were to be found in the three great continental states. But the Government of England considered that her insular position and isolated policy rendered any serious measures unnecessary for her security. There were indeed two little clouds appearing on the horizon; one was a religious war, and the other was the fear of the great maritime power of the day that her sea commerce would be interfered with. The English diplomatists however felt certain that both could be dispersed by a judicious policy of non-interference; and they continued in that placid hallucination until the storm burst upon them. There is a large number of people in England now, who trust to ward off all dangers by the same policy, and who, if they should come, will trust rather, as Queen Elizabeth did, to the general spirit of the people, or even to a contrary wind, than pay a reasonable insurance for the existence of their country.

To my mind, the words addressed to Queen Elizabeth by some learned poet at the time are still applicable:—

> "And now O Queene, above all others blest,
> For whom both windes and waves are prest to fight,
> So rule your owne, so succour friends opprest.
> (As far from pride as ready to do right)
> That England you, you England long enjoy,
> No lesse your friends delight, then foes annoy."

The Position and Power of Spain.

Spain was at the height of that power in Europe, which she so suddenly and in some respects, accidentally acquired. It is no discredit to the Spanish renown, to speak of it as partly accidental; for, although the surprising conquests in America were due to the energy, and chivalry of her people, still those conquests would not have placed Spain in such a dominant position in Europe, if her sovereign had not happened about that time to succeed by inheritance to dominions in Germany, the Netherlands, Italy and Portugal.

Thus Spain seemed to have been placed by Providence in the position to reap the first fruits of the newly discovered ocean traffic; with a seaboard in the Mediterranean as well as the Atlantic, she was able to avail herself of the nautical skill of the Italian and Portuguese, and at the same time to apply the wealth and power resulting from the new world, over her dominions in the old.

Philip had acquired the dominion of Portugal, at the very time when it was most advantageous to him to use its maritime energies towards getting the dominion of the seas; he had added to his inheritances in Naples and Milan, and had thus the benefit of the talent, civilisation and naval science of the Italians. His inherited provinces in the Netherlands contained the most energetic, enterprising and advanced people of the time; but the power they thus possessed was at this time rather a disadvantage than an acquisition to him, for their rebellion had commenced, and to keep it in check occupied a great part of his forces and wealth. Nevertheless the possession was a great advantage to him as far as his affairs with England were concerned, because it gave him a position on the coast immediately opposite the most vulnerable part of England, and an excuse for collecting war forces there, without openly threatening that country.

The Spanish People.

But the marrow of his strength were his own people of Spain. They were still apparently the most warlike and chivalrous people in Europe, and still retained much of the high spirit which had marked them at one time as the most independent of the Gothic races. The result of the long wars with the Saracens, and the subsequent wars going on up to that time in Italy and the Netherlands, had established the Spanish Infantry in the position once held by the archers of England, in Europe: and this superiority was strengthened at that time, by their being more generally armed with the new fire-arms,

than the infantry of other countries. The remarkable religious fervour of the people, though it injured their power as a nation, gave force to them as soldiers. And this great element of strength, was not, as in most other European countries, a merely latent power to be called forth on special emergencies under the feudal regulations, but in Spain it was a fully organised power, and always kept in a condition ready for action. By the help of the wealth from the Indies and from the continuous warfare in his provinces, the King of Spain was able to keep up a force of trained and experienced soldiers, accustomed to traverse Europe and to fight in any country.

The maritime power of the country had culminated in the victory at Lepanto, 17 years before; since that time Spain had been acknowledged mistress of the seas. But there was an element of weakness in it, which caused its speedy fall. It was a seamanship based on the traditions of the Mediterranean and on the navigation of a comparatively safe coasting trade; and unfit to cope in the open ocean with that of the more daring and skilful seamen, trained in the boisterous seas of the North. The very fact of their predominance, led their ocean navigation to take the form of trading with their wealthy Indian dominions, rather than for war or stormy seas.

The internal condition of Spain was favourable to her power in Europe. The peace since the wars with the Saracens, and the commerce and consequent wealth that flowed in from the immense possessions of Spain and Portugal in the East and West Indies, had improved the conditions of the people; and yet the power of the sovereign over the people and resources of the country had become almost absolute. The population of Spain itself was about 7,000,000, or nearly half what it is at present, and the physical condition of the people was probably better. The population of the other European countries under Philip's rule, must have been greater in proportion, because they were then the most advanced countries in Europe; taking them at half their present numbers, Portugal, Naples, Milan, and the Netherlands south of the Scheldt (which was still under Spain), would have contained altogether about 8,000,000.

Thus the King of Spain had supreme power over the finest parts of Europe, containing a greater population than any other kingdom, and those in the most advanced condition of any people of the time; he had also absolute control over greater wealth than any other sovereign, and the largest and finest military force in Europe, and a navy then considered supreme on the seas. No King since him, not even Napoleon, has held such a dominant power in the western world.

That naval supremacy fell, partly because it was accidental to the time, and partly because ocean traffic opened a way for new powers to arise. And the fear of being interfered with and perhaps altogether supplanted in his monopoly of the rich traffic to the East and West Indies, by the bold and skilful seamen of England, was no doubt the mainspring of Philip's determination to invade that country; the reasons ostensibly given, Religion, and the outrages of the English privateers on Spanish property, were sufficient to give a legal colour to it, in the state Europe was in at the time.

The Power of England.

Compared with Spain, England was then, as Mottley says, not more important in Europe than a province of King Philip's extensive dominions. The population of England and Wales was something over 4,000,000, or about one-fifth of the present population, and nearly that of Belgium in 1866. Scotland was still a foreign power, and at that particular time in a state of such doubtful alliance, as to be a subject of anxiety, not of assistance. Ireland was in open rebellion, supported by Spanish help, and therefore occupying the attention of part of the military forces of England, just as the Netherlands was doing to those of Spain.

The internal condition cf England was, however, better than it ever had been before. There had been one hundred years of peace in the land, and under the strong but popular rule of the Tudor Sovereigns, the material prosperity of the people had increased, notwithstanding their religious difficulties. The English mariners, who had been rather repressed during the middle ages, soon began to take advantage of the use of the compass, and in ocean discoveries and ocean traffic, found a field for their reviving energies. Still, it was but a small affair compared with the immense traffic of Spain, or even with the advanced condition of the Netherlands. The great exports at that time were wool and corn. The export of wool to the Netherlands in 1550 was valued at about £1,000,000 per annum: not nearly so much in proportion to population, as the present export of cotton goods to India, and probably the whole exports may be taken at £3,000,000 per annum, which, taking the purchasing power of money to be nine times as much in 1550 as it is now, would be £27,000,000 in this day, or £5 or £6 per head of the then population. There was such a mutually advantageous inter-trade between England and the Spanish peninsula, that it delayed open war between the two countries; but it did not affect the ultimate determinations on either side; these were settled by considerations of religious conviction and political ambition.

The war forces of England were in a worse condition than they ever had been. As there was no army but that of the old feudal regulations, the long peace had led to a neglect of military exercises; not only was the renowned weapon of old England, the bow, dying out, but the new weapon, the fire-arm, was little known from want of war experience. Englishmen had evidently begun to think, as many do now, that war, international war, was as much a thing of the past, as domestic war had been for so long. The English infantry had appeared very little on the battle fields of Europe during the disputes between the great continental nations; and when they did appear, it was in a sorry plight, and, with some brilliant exceptions, to little advantage. The Navy had been neglected during the short reigns of Edward VI and Mary; and it was owing to the opening for sea traffic, that the spirit of English seamanship was preserved to such an extent, that when the occasion came, it alone was prepared to meet the enemy. It is true that Elizabeth, from the beginning of her reign, paid atten-

tion to the defences of the country, but as she was naturally too niggardly to spend boldly, and too proud to call in her Commons to do the work, both the naval and military forces of the country were in a somewhat similar condition to that they were in our own day not many years ago.

"And yet," says Mottley, "the little nation of four millions went "forward to the death grapple with its gigantic antagonist as cheer- "fully as to a long-expected holiday. Spain was a vast empire, over- "shadowing the world; England in comparison, but a province; yet "nothing could surpass the steadiness with which the conflict was "awaited."

The English People.

This was owing mainly to two elements of strength which then existed in England, the powers of which were not fully appreciated by Philip, or by any of the continental nations, at the time. These were *the physical and political condition of the people*, and *the seafaring ability;* and the circumstances of them are worthy of the attention of statesmen at the present day.

In comparing the powers of two nations for conflict, there are two elements of strength to be considered—wealth and population. The measure of wealth, for all ordinary cases of war, may be taken to be the annual produce of the country in agriculture, mines, and manufactures; and in extreme cases it would include every kind of property in the country that has a saleable value. In this respect, taking into consideration all Philip's dominions, European and Colonial, Spain was to England then, very much what England is to Spain now.

But in comparing two populations, not only their numbers must be considered, but their physical, moral, and intellectual condition. The actual physical condition of two peoples may be fairly measured by the respective consumptions of nourishing food; and in this respect the people of England were then superior, perhaps to all other European peoples. Dr. Lyon Playfair has stated that the amount of useful mechanical work stored up in a man, is proportional chiefly to the amount of flesh-forming food he consumes, and from experimental examples of various diets, he considers that 6·5 ounces per day of flesh forming matter, is necessary for a hard-working labourer. Then Dr. Lankester states that the best flesh-forming substance for man to eat is meat, of which matter it contains about 22 per cent.; hence, if the whole of the 6·5 ounces were to be obtained from meat, the hard-working labourer would require 2 lbs. daily. Now, in the sixteenth century, meat was about one-fifteenth of the price it is now. In the reign of Henry VIII, an Act of Parliament, fixing the price of beef at $\frac{1}{2}d.$ a lb., was considered oppressive on the poor. This was owing to the large proportion of the soil of England which was then under natural herbage. But to judge fully of the effect, we must consider the rate of wages; and this consideration is facilitated by the circumstances that the pound in Queen Elizabeth's time, was intrinsically of the same value as it is now. So that if we determine how much food a labourer could purchase in those days, we shall have some sort of

measure of his physical strength, as compared both with other nations of that day and with the labourer of the present day. The average daily wage of a labourer in the early part of the sixteenth century, was 3½*d.* throughout the year: taking meat at ¾*d.* a lb. and bread at ½*d.* a lb. (wheat being on the average at that time 6*s.* 8*d.* a quarter) and beer at 1*d.* a gallon; he could purchase 2 lbs. of meat, 2 lbs. of bread, and a gallon of beer. To purchase the same amounts in the present day would cost the labourer about 2*s.* 10*d.* Thus, in respect of the essential supports of physical strength, the labourer in Queen Elizabeth's time was better off than he is in the days of Queen Victoria.

That this was felt at the time to be a peculiarity of the English people, although its full value was not recognised, was shown in various ways. A State Paper of 1515 says, "what comyn folk in all "this world may compare with the comyns of England in riches, free-"dom, liberty, welfare, and all prosperity." A writer in England in 1577 says, "These English have their houses made of sticks and dirt, "but they fare commonly so well as the King." And one or two others, natives and foreigners, remark on the good feeding of the English, which enabled them to bear arms and fatigue better than the soldiers of any other nation. And the pay and rations of soldiers and sailors was in proportion. Before the time of the Armada, a seaman in the Royal Navy, received 6*s.* 8*d.* a month, and a daily ration besides of 2 lbs. of meat, 1½ lb. of bread, and 1 gallon of beer; being a good deal more than he gets at present, considering the different value of money. The Militiaman cannot be compared with the soldier of these days, because he only got paid when out for exercise; but then he received (1588) 8*d.* a day, equivalent now probably to 4 shillings, or the following extraordinary ration, 2½ lbs. beef, 1½ lbs. bread, 2 quarts of beer, 1 quart of wine, ½ lb. butter, 1 lb. cheese, 1 lb. biscuit!

There is no soldier or sailor in any Army or Navy in Europe, and no labourer in England, except perhaps the navvy, who is fed up to what Dr. Playfair would call such a "war pitch," as was the labourer in the sixteenth century.

The English Political State.

This quality, however, would not have enabled the English to defeat the Armada, if it had not been accompanied by moral, intellectual, and political advantages, which were also peculiar to this country. The whole nation was then organised into one complete body politic, and the people, though technically divided into Catholic and Protestant, had throughout, a deep religious feeling, and a strong sense of their duty to God and their country. Froude says, "The Legislature under-"took to distribute the various functions of society by the rule of "capacity; of compelling every man to do his duty—securing to him "that he shall not be injured by his neighbour's misdoings." Under this system, every man was brought up with the idea that it was his duty to be trained as a soldier to defend his country, as well as in some civil capacity to serve it; and the object of the statesman was

not to increase the wealth of the country by the encouragement of commerce, but the maintenance of the population then existing in a sound and healthy condition of body and mind. The organization of the population was as complete as that of Prussia is now, only it was not as an army for offensive purposes, but as a nation, for religious, civil, and defensive purposes.

Every class in the State was taught that they had duties as well as rights; and as the labourer was so plentifully supplied with food, and having a somewhat independent position from the possession of a few acres of land, which he had by law, he was in a condition to appreciate and perform his part in the State, and ready for hard work and enterprise. England, moreover, was altogether in a better condition than other countries to take advantage of the revival of learning, and also of the new opening for enterprise in the oceans and worlds not long discovered, and now being opened out.

The seamen were good specimens of these characteristic qualities of Englishmen at that time; they are called by Mr. Kingsley, the true descendants of their Viking ancestors; their boldness was that of independent reasonable men, who felt that they had a responsibility in the face of difficulty, and that they had the skill and the power to meet it.

It appears from the foregoing that the power of Great Britain now, in respect of a conflict with another nation, is at least sixteen times as great as it was then. The population is eight times as large, and the exports of the country, which may be taken as some measure of the wealth, are now nearly £10 per head, whereas in those days they were apparently only £5 or £6 per head.

Preparations in Spain.

In the huge isolated palace of the Escorial, by himself at his study table, sits a grey-headed man of sixty, who, from his slight frame and stooping posture, and assiduity to his desk, might have been taken by a stranger for a confidential clerk of the palace. This is Philip II, King of Spain, and ruler of Portugal and parts of Italy, Germany, and the Netherlands, and of both the Indies; who sits here for hours together, day after day, seeing few people, saying little, trusting nobody, but directing the affairs of his vast empire himself, and sowing discord all over Europe by the correspondence dictated in that room.

It is a picture worthy of the attention of all Englishmen, for in that room was hatched the invincible Armada, and those very circumstances of its birth were some of the principal causes of its failure. Philip himself gives to the Duke of Parma, his Viceroy in the Netherlands, the credit of originating the idea of an invasion of England, by way of putting an end completely to the Protestant ascendency in the north; but Philip himself is responsible for the plan of carrying it into execution. It was he who decided that while Parma was preparing troops and means of landing and occupying the country, the fleet that was to protect his passage should be prepared in Spain; and, although Parma was to be the supreme chief of the undertaking, the person command-

ing the fleet was of such rank that he was, in effect, an independent authority. Then, again, Philip ignored the advice of Parma that a proper harbour in the Netherlands, for embarking his troops and to which the fleet could get access, should first be secured; and thus it happened that, when the fleet arrived at their appointed place, selected by Philip, Parma could not bring his troops to them, and the fleet could not reach him without first defeating both the English and the Dutch fleets. Then, the jealousy of the two great Commanders made them each suspicious of the other, under the action of which the fleet left the rendezvous, and never returned.

The habit of secrecy and mistrust, characteristic of Philip II, prevented him from confiding, to any person but the Duke of Parma, the destination of the great expedition he had ordered to be prepared; and he had not the capacity himself to organize the details absolutely necessary for the work to be done. The result was that ships were constructed unfitted to fight those of the enemy they were to meet; proper information was not obtained of the countries they were going to, or proper pilots for the coast; no arrangements were made for insuring the junction of the two parts of the expedition; and, at the last moment, a wealthy nobleman, who had been a soldier, was put in command of an expedition expressly naval. It would probably have given more chance of success if Philip had published his purpose to all the world, as he would then have been compelled by his advisers in Spain to listen to the repeated warnings of Parma. He did succeed in blinding, to some extent, the Governments of Europe, and especially that of the country he had in view—England; but, fortunately for us, he could not altogether lull the feelings of the people of this country, and especially of the seamen. And it may be said to be owing to his boast that he governed the world in secret from his room in the Escorial, that the Armada had in itself causes almost sufficient for its failure.

The actual preparations were probably begun in 1585, when the direct assistance given by Queen Elizabeth to the revolted Netherlands showed Philip the necessity for taking more decided measures against England. But his slow methodical ways of carrying on all the services of his empire, which he had concentrated in his own hands, extended to the Armada, and it was not ready till May, 1588, when it actually started. Thus, again, by his own fault, he lost the opportunity of taking England unprepared. And yet so little did he realise the character of the business he had taken in hand that, when he found the time going by and the preparations in Spain still behindhand, he proposed to the Duke of Parma that he should invade England without waiting for the Armada from Spain, forgetting that it was by his own direction that no war-ships had been provided in the Netherlands' part of the expedition, because the Armada was expressly to convey Parma's forces over.

The King had a large area from which to draw his resources for the equipment of the expedition. Besides the ports of Spain proper, he had the more efficient ones of Portugal, and those of the adventurous Biscayans, and of the more advanced and scientific Italians. The harbours of all these countries were occupied during those three years with the

preparations for the contingents they were to supply towards the great Armada; and from all these countries bodies of horse and foot soldiers were making their way, either to Spain or to the Netherlands, to form part of the invading army. The power of the King was absolute, and the work was blessed by the Pope; for, although the precise destination was not allowed by Philip to transpire, it was well known that, at all events, it was to be employed in the service of the Catholic Church against the heretics. And yet, notwithstanding these powerful influences, it was not till the beginning of May, 1588, that the whole force was assembled in the Tagus, ready to start. And before that time, another act of Philip's had struck a heavy blow against the prospects of the expedition. The first commander appointed to it was the Marquis of Santa Cruz, a man of considerable naval experience; under his superintendence the preparations were made, and under his guidance it might have had a different issue. But the ignoble spirit of the King was influenced by other favourites to discredit this naval noble, and in so evil-minded a manner that the Marquis died of chagrin three months before the Armada sailed. Then, to complete his mistake, he appointed to the command, the Duke of Medina Sidonia, whose capacity for it, as compared to the other, was marked by the saying that "to the iron Marquis succeeded a golden Duke." He was a grandee of vast wealth, with little capacity, and less experience.

List of the Spanish Armada that sailed from Lisbon at the end of May, 1588.

	Commanded by—		
The Portuguese squadron	The Duke of Medina Sidonia	12	vessels of various kinds.
„ Castile „	General Diego Florez de Valdez (the most experienced sailor in the fleet)	16	do.
„ Andalusian „	General Pedro de Valdez	11	do.
„ Biscayan „	General I. M. de Recalde (the upper Admiral)	14	do.
„ Guipuzcoan „	General Miguel de Oquendo	14	do.
„ Italian „	General M. de Bertendona	10	do.
„ Urcas „	General Gomez de Medina (store ships)	23	do.
Tenders, caravels, &c.	General A. H. de Mendoza	22	do.
The galeasses of Naples	Don H. de Moncada	4	
The galeras, or galleys	Captain D. Medrado	4	

The second in command was Don Al. de Leyva, and Don Fr. de Bobadilla and Don D. de Pimentel were chief officers.

The total number of vessels given by Don D. de Pimentel was altogether 145, of which 110 were men-of-war, and 90 very large.

The total tonnage of the whole fleet was	59,120	By Mottley, on the authority of Spanish writers.
„ number of guns	3,165	
„ „ soldiers	19,265	
„ „ mariners	8,252	
„ „ galley slaves	2,088	

Don D. de Pimentel said that daily allowances were issued for 32,000 people.

The size of the men-of-war varied from 300 to 1,200 tons. Pimentel's own ship (a galeass of Portugal) was 700 tons.

The galleons were huge, clumsy vessels, with round sterns, built up at stem and stern like castles, and with bulwarks musquet proof, and the lower work four or five feet thick, which was proof against small guns.

The galleys were rowed by slaves, who sat amidships; the bow and stern had each enormous towering structures, like castles. The cannons were placed both in these and between the benches of the slaves.

The galeasses were similar, but one-third larger; each of these was rowed by 300 slaves.

Pinaces and caravels were small sailing vessels, about the size of modern yachts.

All the vessels were over-weighted with top hamper in proportion to their draught, and could bear but little canvas, even in fine weather.

A large vessel carried 63 guns; Pimentel's carried 32; but one-third of the guns were of cast-iron. There were at least 40 rounds of ammunition per gun.

The Spanish soldiers on board the Armada contained the picked veterans of Spain, and were considered to be the pith of the whole expedition.

The Armada was said to be provisioned for six months. A Spanish record made by order of King Philip, gives the following list of provisions on board:—

110,000	quintals of	biscuit.	The quintal being 101·4 lbs. avoirdupois.
6,500	,,	bacon.	
3,458	,,	goats' cheese.	
8,000	,,	fish.	
3,000	,,	rice.	

6,320 septiers of beans or white peas (of $1\frac{1}{2}$ bushel each).
14,170 pipes of wine (of 110 gallons).
11,398 arrobas of olive oil, } of $3\frac{1}{2}$ gallons each.
33,870 arrobas of vinegar, }
11,875 pipes of water.

which would be a poor provision for 30,000 people for six months. It gives, however, some notion of the difference in feeding of the Spaniard and the Englishman of that time.

The same authority gives the following arms on board:—7,000 arquebusses, 1,000 musquets, 10,000 pikes, 1,000 partisans, 6,000 half-pikes, so that the proportion of fire-arms to soldiers was nearly one-half; a greater proportion than in the English forces; and the Spaniards had, no doubt, better fire-arms, and were more practised in their use.

Construction of Spanish Ships.

Sir W. Monson, an Admiral of those days and a great naval critic, had not a high opinion of the Spanish navy. He says their vessels were generally constructed for commerce rather than war; that they were commanded by soldiers who were ignorant of the sea and despised the real seamen; that Philip had to get ships and seamen from other parts of his dominions than Spain; the good vessels in the Armada

being other than Spanish; and that generally the English were at that time superior to the Spanish at sea; but this was owing, not to the construction of the ships, but to "the irresolution and insufficiency of the men." One is rather surprised to hear this of the conquerors of the New World and rulers of an empire on which the sun never set, but we must recollect that it was the Portuguese who first led the way in maritime discovery, and that Philip had the control over the naval resources of Portugal, which he used for the Armada to an extent disastrous to that country.

Sir William enters into the discussion of construction of vessels with a zeal that would have given him a prominent place in naval literature had he lived in the days of ironclads. He does not coincide in the opinion we find expressed by other sea captains of the time, of the advantage of the small handy English ships; for, as he puts it, in a maxim worthy to be handed down by English sailors, "when you speak of the strength of ships, you must speak of the sufficiency of the men within her." Sufficiency, not of quantity, but of quality. Therefore, he says, "I would rather desire a reasonable ship of the King of Spain's manned with Englishmen, than a very good ship of Her Majesty's manned with Spaniards." In short, he leads us to infer that, in his opinion, the Spanish Armada was defeated, not by superiority of ships, but of seamen; a view of naval warfare which, in these days of scientific naval construction, ought not to be obscured. Indeed, he commends the galleys, vessels which failed beyond all in the Armada, and especially the "galliass of Venice," as "low and snug by the water," "carrying the force of a ship in men and ordnance;"—"not swift, but certain"—in fact, the "Devastation" of her day. Thus we learn, from the criticisms of this expert of the time, that, although the size and construction of ships may alter from age to age, the different classes of them necessary for naval war will remain much the same throughout all ages, and the main naval strength of a country will always depend on the quality of the seamen.

Preparations in the Netherlands.

The Duke of Parma, King Philip's Viceroy in that part of the Netherlands which still acknowledged his rule, was considered one of the best soldiers of his day, and was, besides, an able ruler and diplomatist. If Philip had put the whole affair of the invasion of England into his hands, the issue might have been very different; but, fortunately for this country, Philip's habitual distrust made him limit Parma's action to the preparation of the main body of the land forces required, and Parma appears to have done his part with completeness, zeal, and caution. For he had his forces fully equipped for their work long before the Armada was ready; and during the whole time the preparations were going on, he succeeded in so blinding Queen Elizabeth and her councillors, that negotiations for peace were carried on up to the last minute; and one of her Commissioners in the Netherlands writes confidently of Parma's pacific intentions on the day when the Armada was having its first engagement with the English fleet.

By April, 1588, Parma had collected, under pretence of subduing the newly united Provinces, and of checking France, a force of the following composition and numbers:—

Infantry.—	Spanish	8,718
	Italian	5,339
	Burgundian, Irish, and Scotch	3,278
	Walloon	17,825
	German	19,925
	Garrisons of fortresses	1,180
		56,265
Cavalry.—	German	3,650
	Foreign mercenaries	668
	Total	60,583

Of this total force, it was expected that about 30,000 would be available for the invasion of England; and this 30,000 had dwindled down to 16,000 by August from sickness and other causes.

These were collected from all the dominions of Philip, and contained many experienced and celebrated bodies of troops. There was the Terzio or Legion of Naples, 3,500 strong, every man in which had armour either inlaid or gilded; and the young adventurers, Catholic nobles of Europe, flocked to the Netherlands to serve under so distinguished a leader on so important an expedition. He had already prepared, during the year 1587, a large stock of war material suitable for the undertaking: rafts and oars for landing, fascines and sand-bags to form temporary shelter at first, timber for stockading quickly the posts occupied, barrels and superstructure for temporary bridges, special carriages for quickly getting his field guns up on landing; and he had built, or purchased from the North German ports, 400 vessels, which he describes as mere transports, many of them flat-bottomed, and incapable of making any fight at sea; although both Philip and the English appear to have thought he had an independent war fleet, and, by acting on that belief, caused difficulties on both sides.

Parma had desired to obtain possession of Flushing beforehand, a deep water harbour, into which the Armada could have entered, but as he could not make his master understand the absolute necessity of having such a harbour to effect the junction of the two parts of the expedition, and as Philip was earnestly pressing him to be ready, as the Armada would join him in the autumn of 1587, he had to content himself with taking Sluys, which he was able to effect, owing chiefly to the supineness of Elizabeth, who would not expend money towards its defence. Thus he had three small harbours, Sluys, Newport, and Dunkirk, for embarking his forces; and he made a canal from Sas de Gand to Sluys for his transport vessels, as the ordinary channels were in possession of the United Provinces. But these three harbours were inaccessible to the large vessels of the Armada, and as they were carefully watched by the Dutch fleet, he and his elaborate preparations were unavailable until the Armada could clear the seas of

the two hostile fleets. Parma excuses himself from blame in this matter by reminding Philip that he was expressly instructed to depend on the Armada for securing his passage across; that alone would hardly be sufficient explanation to clear so powerful a Viceroy; but he also complains of deficiency of the money promised for these objects—a deficiency which was probably caused by Walsingham's financial manœuvres on the Bank of Genoa, as related by Burnet.

Cost of Spanish Preparations.

The cost of the whole of the Duke of Parma's force, military and naval together, is recorded as 454,315 dollars per month, or, taking the dollar at 4*s*. 2*d*., it was £94,649 per month. The cost of the naval part of the Armada itself is recorded as 12,000 ducats per day, which, taking the ducat at 5*s*. 2*d*., would be £93,600 per month; and the cost of the whole expedition, including both that from Spain and that in the Netherlands, is recorded as 30,000 ducats per day, or £234,000 per month. Froude says, the total cost of the Armada was expected, in 1585, to be 4,000,000 of gold crowns, which, at 5*s*. 2*d*., would be about £1,000,000 at that time. There must be some mistake in this, because, in 1587, Philip told Parma he had 6,800,000 ducats ready for the expense of it, which would then have been upwards of £1,500,000.

Thus one can see that there was an element of failure in the Armada itself. But, besides that defect, it was not so very powerful an expedition, considering the resources of King Philip, at least, compared with armaments of our time. Taking the population as a standard, and assuming the population under the control of Philip for these objects, at 15,000,000, the total tonnage of the Armada gives one ton for every 250 persons, which we shall find was much less in proportion to population than what was provided in England to meet it, and is less than the tonnage of the ironclad fleet of France in proportion to its present population. The total number of persons engaged both in Spain and in the Netherlands, bears about the same proportion to population as the army for the invasion of England prepared by Napoleon in 1803; and in each case it may be assumed that the full power of the invading country was put forth. Then again, although the tonnage of the Spanish fleet was much larger than that of the English, the Spanish ships carried fewer sailors per ship, and had on the average 200 persons per ship on board, so that they were transports as well as fighting ships, and with less manœuvring power.

Nevertheless, it was acknowledged by all Europe to be a splendidly appointed and very powerful expedition; and the forces themselves looked upon success, not only as certain, but easy. If religious enthusiasm, chivalrous spirit, and military skill could ensure success, they had reason to be confident; for the expedition contained the choicest of that Spanish race which had so distinguished itself in the world, from the noble to the veteran soldier; and there is no doubt that they were animated with a sincere belief that their cause was approved by Heaven. The experienced seamen among them had, however, already felt that the English seamen were more than a match for

them at sea; and the whole Armada had to acknowledge, in the end, with the bitter disappointment of brave men, that success on the ocean belongs to those who are born to the sea.

Preparations in England.

When we turn to the preparations made in England to resist this great expedition, we find a remarkable contrast, both in the matter of the preparations made, and in the manner of making them, which illustrates the genius of the two nations, as well as the character of their rulers. We find a Sovereign desirous of peace, and parsimonious, but forced into a great war by the bold determination of her people. It is an instructive example to the rulers of Great Britain for all time, of those eventful periods which have occurred sometimes in our history, when the sound instincts of the people have risen to direct their reluctant governors in the right path of England's duty.

Queen Elizabeth, with all her intellect and high courage, and loyalty to her faith and country, inherited the despotic feeling of her family, and added to it a closeness of her own, and a womanly attraction towards peace. Her arbitrary aversion to appeal to her Commons, and her remarkable repugnance to spend money, nearly counteracted all the efforts of the country. The contest was virtually between Philip and all England; and the monarch discovered the mistake, as others greater than he have done, in backing himself against such a field.

The one remarkable, and encouraging and instructive feature about the preparations in England was their *complete localisation, both materially and in spirit.* No doubt this was fostered (as Mr. Mottley says) by the two new passions that had taken hold of the English mind, revolution against the Pope and mercantile adventure, which were now combined with the old martial spirit of the people. The first feeling had been used as an incentive against Spain, for three years before the Armada, from the pulpits of the Church; that is about the same time that the Queen determined to give material support to the Protestants in the Netherlands. The second was kindled into new life by the opening of the splendid traffic of America, and necessarily the old seafaring spirit of the Northmen was both roused and made antagonistic to the Spanish claims in those countries. Thus the people of England were quite prepared in spirit to take up any gage of battle thrown down by Philip.

But though this localisation affords us so useful a lesson in some respects, it must not be forgotten that it nearly failed in saving the country, and that the cause of its want of efficiency was the absence of that very central motive power which was so injurious in Spain. The one part of England's defence which was successful, the Navy, owed it to that unity of authority combined with individual enterprise, without which it could hardly have existed at all. Thus we learn, that as in each country the system of national defence must be suited to the national characteristics of the people, so *in England no system will be thoroughly national and thoroughly effective which does not combine a powerful central direction, with local liberty of execution.*

Without the latter, the true spirit of the English people will not be roused; without the former, that spirit will be of little value against an enemy.

Queen Elizabeth acted in a perfectly legitimate manner in calling upon the counties to raise and organise their quotas of armed men for internal defence, indeed, she had no other means of raising any land forces. The old feudal duties of subjects had not then expired, though they had been modified (to meet the altered state of the country after a long peace) by the allowance of substitutes or money payment instead of personal service. In Elizabeth's reign this feudal duty was organised by counties, and the Lord-Lieutenants of counties were made the Queen's representatives for seeing the order properly carried out; each county was subdivided among Deputy Lieutenants, also appointed by the Queen, and under them were captains of horse and of Foot, who were generally officers who had served in foreign wars. The quota of horse and foot to be furnished by each county is given in the State Papers, and even that of certain individuals, justices of the peace, bishops, and others. They were all to be furnished, clothed, armed, victualled, lodged, and munitioned, at the expense of the county for a certain time after enrolment, after which, if kept embodied, it was at the Queen's expense. This was a happy arrangement for the great, but penurious Queen, but a very unfortunate one for the necessities of the country; for the Queen took care that they should never be in training long enough to come under her charge, and the counties were not eager to incur the expense of the training without having the necessity strongly brought home to them.

False Economy of the Government.

Two remarkable instances of the Queen's unwillingness to incur expense in war, and to bring matters between herself and Philip to such an issue, occurred in 1585 and 1587.

In 1585, the newly-united Provinces of the Netherlands sent to offer the sovereingty of their country to Elizabeth. Notwithstanding her decided predilection for the reformed faith, and her fear of the power of Spain; and, notwithstanding the warning of some of her counsellors that, if she did not fight Philip in the Netherlands she would have to fight him in England, she not only refused the sovereignty, but snubbed the deputation, and only agreed to help them with troops on condition of her favourite Leicester being made Governor of the Netherlands and of her receiving some towns as securities. She sent over some 10,000 men, of all sorts, but as she soon ceased to pay them, they became a trouble instead of an assistance to her Dutch allies. Her repugnance to join heartily with the United Provinces was, perhaps, partly due to her tendency for diplomacy, in which, however, she was no match for the unscrupulous Philip, and his still more unscrupulous viceroy, Parma. But the mainspring of her action seems to have been fear of spending money. Secretary Walsingham says, in 1586, "rather than spend £100, she can be content to be deceived "of £5,000;" "Her Majesty and her Council do greatly stagger at

"the excessive charge;" "She scorneth the peril (of giving up the "cause of the Netherlands); the hope of peace with Spain has put her "into a most dangerous security." One cannot but think that, if she had carried on a bold war in the Netherlands, the Armada would have been forced on before its time, and England would have come out of the struggle holding a much higher place in the world.

But though the English land forces were thus losing precious time for want of resolution in the Government, the English navy, with equal spirit and more confidence in themselves, was not tied down by the same leading strings. Sea expeditions not being then considered to be actual war, and every merchant ship being prepared to fight, it had long been the custom of the adventurous sea captains to fit out expeditions, especially against Spain, partly private and partly supported by the policy of the Government. It was not, therefore, difficult for Sir Francis Drake to get up such a combined expedition to discover what the Spaniards were really doing in the matter of the Armada. For, by the spring of 1587, says Stowe, "the commonalty began to entertain a stronger opinion touching the Spaniards' settled resolution for the invasion of England than either Queen or counsel." And Drake was the popular hero of the cause, just as Nelson was afterwards against Napoleon. And good service he did. With 4 Queen's ships and 24 merchanters, he entered Cadiz harbour, silenced the forts, beat back 12 great galleys, and destroyed 10,000 tons of shipping; and repeated the performance in the Tagus, under the eyes of the Marquis of Santa Croce. By which performances he not only delayed the Armada for another year, but produced the more important effect in war of shaking the *morale* of the enemy, and "taught the mariners of "England how to handle those great galleys," but, though Lord Burghley himself gives this testimony to Drake's exploits, he is obliged to add, "Her Majesty is greatly offended with him." The attacking Spain itself was carrying the little game at sea rather too far for her cautious policy; she sent an express after him to forbid it, but fortunately for all parties, there were no electric telegraphs between London and Plymouth in those days, and she was enabled to make political capital out of her attempt, and at the same time reap the benefit of Drake's misdemeanours.

Detail in Counties.

The preparations on land for defence were extremely well elaborated on paper. There were to be three distinct armies, and a reserve; forming, one may say, three lines of defence. The first line, that "to "encounter the enemy on his descent," was to consist of 34,262 men, spread along the south and east coast, and to be furnished by the counties bordering on that coast. The second line was to consist of 22,872, stationed at Tilbury, because it was expected that the descent would be made in Kent or Essex, and was to be furnished from the midland and southern counties. The third line was to consist of 28,900, and be stationed near London, and considered as the Queen's guard, and was to be furnished by selected troops from all the counties. The reserve, 46,145, was to remain in the counties, to be used as required. These make a total of 132,179; but, in addition to them,

there were the quotas to be raised in Wales, amounting to 9,377, which are not included in any of the above; also, those in Yorkshire and Durham, which formed a separate command of about 14,000 and then there are nine northern counties not mentioned at all, so that the total force calculated (on paper) to be raised in all England and Wales must have been nearly 170,000.

The great principle at the bottom of all these proceedings was, that every man in the country, if he was able, was bound to assist in the defence of it. The returns from the counties give the number of "able men" above 16 years old, and also the number "furnished" to "armed;" but these returns are evidently not trustworthy, for, on the whole, the number of able men returned is not above double that taken for service. Now, Sir W. Raleigh estimated the number of men capable of bearing arms in England, at that time, to be 1,172,000; a much more probable number when we consider that, in 1841, the male population of England, between the ages of 16 and 45, was one-fifth of the whole population.

This 170,000 would have been a respectable force in proportion to the population of about four millions, if it had actually existed and had been trained and armed; it would have been *one twenty-fifth of the whole population*. The present military forces of Great Britain, including Volunteers, are about *one sixty-fifth* of the population. The war army of North Germany, including Landwehr, is about *one thirty-fourth* of the population, but, including the Landsturm authorised in 1874, it is about *one-fifteenth* of the population. But the numbers actually embodied fell very far short of these, and the training and arming were still more lamentably deficient; and the fault that it was so, lay more with the Government than with the people.

Norfolk.

It is when we turn to the details of arrangements in each county that we see the genius of the people really appearing. As early as 1586, instructions were given to the Lieutenants of counties, but they only mentioned generally the different points that were to be considered, leaving it to the county authorities to apply them to each locality. Mr. Bruce gives, as an example, the arrangements made in the sea-coast county of Norfolk—not one of those most threatened—and which appear to have been due to Sir Thomas Leighton. Eight places on the coast, considered to be those of greatest danger "by "reason of the good roads into the interior and the depth of the sea "inshore," were selected to be fortified temporarily and to be the guard-posts of the forces. Two of these, Waburne and Yarmouth, were selected as the centres of defence. The whole force of the county, about 3,000 foot and 250 horse (which is about the average of each county's quota for the first line of defence) were divided into two divisions, one to each of these two places, and each of these into three or four subdivisions; so that, in each subdivision, there were about 300 foot (half of whom were "trained" and half "untrained") and 40 or 50 horse, of whom about one-fourth were "Lancers" (or regular cavalry) and the remainder "light horse," which probably meant the

yeomanry of the time. With each subdivision there were some 70 pioneers, with spades, picks, shovels, axes, bill-hooks, and "brown-bills," and a few artificers (carpenters, smiths, and wheelwrights), and two carriages.

The subdivisions were told off (by name of captain's) to take duty by the week at one or other of the above two centres (as convenient to their locality), to keep guard and go on with the defences. On an alarm (by beacon fire), each full division was to repair to its centre. The remainder of the able bodied population were to assemble at certain appointed places in their respective hundreds, and wait further orders from the Deputy Lieutenants.

If a division was driven back from the coast, the whole force was to retreat on Norwich, which was to be victualled with that intention, and Mount Surrey was to be intrenched and defended, as well as the castle, and certain named bridges, over rivers between Norfolk and the coast, were to be prepared for defence, and for destruction. On retreat from the coast, no carriages were to be left, all corn that could not be carried away was to be destroyed, and cattle driven into marshland, and the bridges on their route destroyed. The chief constables were to appoint the watchers of beacons, and watchmen at every bridge, and post-horses in continual readiness, at all needful places on the coast, to carry information; also, a foot-post in every parish, and a horse-post in every market-town. If the enemy could not be impeded from marching on London, the county force was to follow close on him, to hinder as much as possible his spreading and foraging over the country.

Arms.

The clothing was supplied by the county, and cost about fifteen shillings a head. The arms were either purchased or "requisitioned" from private individuals. It was an unfortunate period, in this respect, for England's position; the old English long-bow was giving way before the musquet, the latter not only required more skill and training, but they were more difficult and more expensive to obtain.

The advantage of a weapon like the long-bow to the English people was, that it could be used to full advantage only by a strong bold race. It was, moreover, so easily attainable in the country itself, that every labouring man could provide himself with one, and the regulations for practice throughout the country placed the means of keeping up his skill within easy reach of every man. It was no despicable weapon in the hands of well-fed Englishmen: the effective range was from 300 to 400 yards, and an arrow could be discharged every two or three minutes, with fair certainty of hitting a man at that distance; whereas the new firearm, though it carried farther, required fifteen minutes for each discharge, and was not very sure of its mark even then. The introduction of breech-loaders, also a weapon that requires bold and skilful men to bring out its qualities to full advantage, appears likely to restore to the English infantry some of that superiority which they held with the bow in the middle ages.

In Norfolk they desire, "if possible, 45 musquets for every 300

"men," and though London could muster 4,000, "chiefly shot," in other parts of the country, only about one-third of the whole force were armed with musquets, harquebuses, or calivers, the remainder were armed with bows or bills. The horsemen were so few in number (about one-fifteenth of the whole in the southern counties) that they could only be considered as patrols; and of these about one-fourth were armed with lances, and half that number with harquebuses or petronels. The Queen appears to have supplied few if any small arms; her stock of them had, perhaps, been used up in the Netherlands, and they were not made in England. But ammunition could be procured in England, and if there was one article that a foreseeing Government would have taken care to ensure the supply of, at such a time, it was surely gunpowder. The only advantage, however, given to the counties, in this one matter, was the liberty to purchase the Government powder below the market price; and the want of forethought in providing for the supply for the Navy very nearly snatched the well-earned victory out of their hands.

The Sea Coast.

The ordnance were, most of them, supplied by Her Majesty, and the gunners also, for in those days such things were "caviare to the multitude," but the counties had to pay for them. Both bronze and iron (cast and wrought) guns were made in England at that time, and of such character and number that other nations sent there for them. The official report of the proposals for fortifying and arming the coast of Sussex (which was published by Mr. Lower in 1870) affords probably a favourable specimen of what was done generally. Along the 90 miles of the coast of this county it was proposed to place altogether 114 guns, the greatest part of which were to be demiculverins (9½ lbs. ball) and sacres (5¼ lbs. ball); only in Winchilsea Castle (or Camber, as it was called) and Rye there were a few cannon (60 lbs. ball), curtal cannon (41 lbs. ball), demicannon (30½ lbs. ball), and culverin (17½ lbs. ball). Of the above, 6 sacres were to be mounted and used as field-pieces, and this was the proportion of field-pieces proposed for each of the southern coast counties, for which they were to provide teams of horses, and carts for ammunition. For the field-pieces one hundred weight of "canon corn powder" was to be provided per gun, which, at an average charge of 4 lbs., would be 28 rounds. It is curious that the points selected for defence on the coast of Sussex are almost exactly the same as those selected by a committee for the same object in 1870, showing how little the general features of the coast have altered in three hundred years; and that the "sconces, trenches, flankers, and scarpings" then recommended would be equally, even more applicable to our modern arms of precision. The sea-coast is an everlasting defence, suitable for all ages, requiring, in addition, only parapets to cover the defenders, and the greater the precision and quickness of the weapons, the more suitable is the sea-coast for a line of defence. The number of guns is about the same as that proposed in 1870, though, from the immensely increased size and range of them, they can now be placed to greater

advantage along the coast. In Norfolk, places were selected where the sea-banks were to be cut to flood the levels.

The second line of defence, the 22,000 men of Tilbury, was well placed to meet what was pretty well known to be the direction of the attack, for there was a floating bridge (made of "western barges") over the Thames there, so that the troops from the north could cross over in time to take an enemy on the flank, if he landed in Kent or Sussex. And there were batteries at nine places between Tilburyness and Woolwich, and another floating-bridge at Blackwall.

Kent was remarkable, not only for the large proportion of soldiers actually raised and armed, but for the number of mounted musqueteers —a peculiarity which seems to be handed down to the present day.

But if the county Militia made but a poor show in numbers, arms, and ammunition, their rulers seemed to think, with Henry V, that it was more to the purpose to "show the mettle of their pasture;" for they were better paid and fed than any soldier is now. The Dorsetshire labourer would be glad now-a-days to enlist if he got 4*s*. a day, which is the present equivalent of the 8*d*. a day the Militiaman of his county got then, when on duty; and the Militia Captains would, no doubt, be glad to return to the rate of £5 per day of training, which they got then. There was a good commissariat staff to ensure the supplies, two purveyors, one surveyor of victual, and one carriage-master to each division of a county, and a victualler to each captain; but evidently, from the rations allowed, there was no control department.

We may smile at the idea of the 3,000 men of the Norfolk militia attempting to stop the 30,000 veterans of Parma, from marching upon London; but the very fact of the county people alone proposing to do it, is an evidence of the bold and patriotic spirit that animated them. The letters and reports from the counties at this time, are full of the English fearlessness of danger. Lord Sussex from Hampshire, writes, "the poor say, he that would not sell horse and cart to defend his "country, it were a pity he had any." Sir T. Scott in Kent, though the Queen is drawing largely on his forces for her own body guard, seems to have no fear of the result. Stowe, the London Merchant-tailor and chronicler, describes, "the cheerful countenances of the "soldiers marching to Tilbury—joyful at the news of the foe's "approach—and when they heard they were fled, began to lament." The Earl of Pembroke offered 300 horse and 500 foot, armed, at his own cost. The city of London was asked for 5,000 men and 15 ships; they voted 10,000 men and 30 ships.

Supineness of the Government.

But all this time the Queen and her Council, who should have appointed men with authority and ability to superintend the drilling and disciplining of the county forces, and have raised funds to supply and pay them, contented themselves with writing despatches to the Lord-Lieutenants, in an official style worthy of the most bureaucratic Government. In 1572, a Royal Defence Commission was appointed; the Queen was already alarmed, and apparently wished to make a show

of doing something, for nothing seemed to have been done till 1586, when instructions were issued to the Lord Lieutenants, which were repeated with additions in the spring of 1587, and yet at the end of that year (when, be it recollected, Philip intended to have done the deed), Lord Treasurer Burghley, in issuing further instructions, incidentally remarks that he has received no returns or answer to his former ones, and though, in the course of these instructions, he talks very wisely about foreseeing things in time, and by due preparation, serving the purpose with fewer soldiers; he also desires "certificates in writing as "to the execution of these orders, *yearly*!" and in April, 1588 (the Armada then starting), he once more complains of receiving no replies, but "the Queen *hopes* they have put in execution her former orders." And then, after the manner of dilatory administrators, he got frightened, and Sir John Norris was appointed Captain-General over the maritime counties, to consider among other things "whether it be "not convenient to have some troops in such places as the enemy are "likely to land (considering the enemy is in a readiness), *to be con-* "*tinued for a time in Her Majesty's pay, whereof some part to be borne* "*by the county*."

No wonder the people took it easy in their preparations, when there was so little earnestness at head-quarters: and no wonder Sir E. Stanley, in Cheshire and Lancashire, found that there had been no training (even for the regulated six days) for two years past, and little desire to spend money on preparations; and that the Spaniards (well informed from England) conceived the idea, that through the peace of thirty years, the English had become "a pacific, delicate, "effeminate race, dependent on good living, without experience of war, "quickly fatigued and discouraged;" when some of the best Englishmen could fear of the effect of "our long quietness," and say that "God had stirred up the war in the Low Countries, to be a school, to "breed up soldiers to defend the freedom of England; which through "these long times of peace and quietness, is brought to a most "dangerous state."

Indeed, things were looking very bad on land in England. On the 8th August, 1588 (the Armada then being at Calais) there were only 4,000 men in the camp at Tilbury, and those by no means effective. Of the army of London, the Queen's Guard, there only existed the contingent supplied by London itself, and the Commanders had a very poor opinion of that. The county forces were probably at their posts, but we may presume from the above, that the reserve was—where reserves appear generally to be—nowhere. Lord Huntingdon (commanding in the North) says, in June, that he wants "Money, men, "armour, ammunition, and victuals." And even the favourite Lord Leicester, who was put in command of the imaginary force at Tilbury, is constrained to speak out by August, with more force than grace: "I see many causes to increase my former opinion of the dilatory "wants you shall find upon all such hurley burleys—I prefer Her "Majesty's life and safety, and the defence of the realm, before all "sparing of charges in the present danger,—play not away this king- "dom by delays—Her Majesty must deal liberally. 'For your

" 'army, it is more than time it were gathered about you' (this is to the Queen herself)—'for the placing of it, no doubt, I think, about " 'London the meetest—so soon as your army is assembled, let them " '*by and by* be exercised.' " These sentences are emphatic, when we consider that the enemy was at the gates when they were written.

We are obliged moreover even to blot out that historical chivalric visit to the army of Tilbury; not that the Queen was wanting in the personal valour of her race, by any means, but for the simple reason that there being then no army at Tilbury to visit, the celebrated occurrence did not take place till after the Armada had disappeared from the scene. Had she gone before, the famous Governor of Tilbury Fort might have said as truly of the British Army as he did of the Spanish Fleet; "the British force thou canst not see—because there's none in " sight."

Comparison with Present Forces.

But what a lesson this is to all rulers of the British empire, on the defence of the islands of Great Britain itself. There were men enough then, with strength and spirit enough in them to make a very fair resistance to the landing and advance of any invading army, if they had been embodied, and trained, and disciplined, and armed in time: and if the practice of the bow had not been allowed to die out, before that of the new fire-arms commenced. As it was, if by any accident the invaders had got clear of the British fleet, there was nothing that could be called a serious obstacle, to stop them from capturing London. *If that same proportion of one twenty-fifth of the whole population, was now trained, it would give a force of one million, which would be sufficient to place* 350 *men per mile round the coast of England.* And if the favourable landing places were prepared beforehand, with cover for the defenders and obstacles against the invaders, and the men were armed and well trained with breech-loading rifles, that number would go a very great way towards defeating altogether, any attempt at landing by the greatest possible force that could land on a given distance. It would be a force like the ancient county Militia, levied, trained, and fighting at the places they lived in, and would, therefore, tend more than any other, to keep up the martial spirit of the people. But it is evident from this part of the story of the Spanish Armada, that if any dependence is to be placed on any such force, it must be so organised, that there will be no fear that they will not always be accustomed to discipline, and well trained in the use of the rifle: and I think, after what we have heard, it would not be amiss to add, that they should at least while embodied, be well fed.

And now what proportion of that armed million of Englishmen, are we prepared to raise on such an emergency? 130,000 partly trained militia, and 150,000 volunteers, who, as their title implies, may come or stay as they please. For the rest of the security of our great empire, we depend on 150,000 regular troops, who are just enough to occupy our military posts over the world in peace time; and to reinforce whom on the outbreak of war, we have at the most about 30,000 old soldiers. Thus, taking the favourable view that all those numbers would be

forthcoming on sudden demand, we have under 500,000 men, or one half of the proportion of the population considered necessary in 1588; and to defend an empire, probably twenty times as great. The security of our dependencies, none of which existed in those days, would now absorb the whole power of those 150,000 regular soldiers, leaving our own shores to be defended by a force of militia and volunteers one-third the strength of what the founders of our empire would have raised.

Cost of Land Forces.

The cost of all the forces and all the preparations made on land for the Armada, cannot be easily obtained, if at all; because the bulk of it was raised and paid in the counties, without the intervention of the central authority. If we judge by the rate of pay to the officers and men of the Militia, it was a much more expensive army than our present regular force. Mr. Bruce gives the statement from the county of Northampton in 1588, of the expenses of levying, clothing, and supplying with ammunition and their stores (not arms), and pay for five days' training, for 600 men, which amounts to £1,172; of which the pay of the men was only £86. In 1872–3, the pay of the rank and file of the British forces amounted to about one-fifth of the estimate for the whole expenses of the effective force. If we assume that the pay of the rank and file of the Militia at the time of the Armada was half of the whole expenses, we shall probably be near the truth. Taking that proportion; and assuming the whole 160,000 to have been embodied, and that the pay of heavy horsemen was 1*s.* 6*d.* a day; that of the light horseman 1*s.*, and of the footman 8*d.*; the total cost of the whole rank and file would have been nearly £250,000 per month; and the total cost of the whole preparations on land would have been £500,000 per month; and if we take the purchasing power of money in the necessaries of life, at that time, to have been six times as much as it is now, the above sum would be equivalent to £3,000,000, or about 15*s.* per head of population *for the month.* The total cost of the British Army and appliances for 1872–3, was estimated at £14,824,500, which would be less than 10*s.* per head of the present population, *for the whole year.*

It is true that during the time this Militia force was not embodied, there was hardly any charge upon the country; but considering that they were in fear of the invasion for a whole year, the whole force must have been embodied for a period of altogether three months; at all events we may assume that the country was quite prepared to pay the necessary expense for such a time. This would, therefore, have been equivalent in our day to £9,000,000; and if we take the difference in population into account, it would be equivalent to our spending £72,000,000 on a war that lasted three months, and that for the army only.

NAVAL PREPARATIONS IN ENGLAND.

The aspect brightens when we look towards the sea. Not that the Government used more diligence on the sea, than they did on the land,

but the English Navy had a field for their energies more independent of the Government. Fortunately for England, the people had never lost that attraction to the sea, which made it seem part of their country; and the maxim of Alfred, "That England only enjoyed peace from "invasion when her fleets were powerful enough to repel it from her "shores," had never been altogether forgotten. In the reign of Elizabeth, the new field for sea enterprise in the Indies, coming at a time of comparatively long peace, had revived the national predilections, and had created a race of adventurous seamen, and made the fleets of England once more claim dominion on the "narrow seas." Thus there was a material of ships and experienced seamen ready to make use of, and in the temper to use themselves.

It is somewhat difficult to arrive at the precise numbers of vessels in the Royal Navy and of merchants employed on this occasion, because the numbers are given for different days of the whole affair, in the course of which some became disabled and others were added. By taking the names of all vessels of all kinds mentioned in the records of the time, as given by Bruce and Dodsley, it appears that the following numbers were employed at one time or other:—

	Nos.	Tonnage.	Guns.	Men.
Royal Navy	35	12,690	658	6,361
Merchant and private ships	161	20,000	400[1]	9,070

These were divided into two fleets; one under the Lord Admiral, Lord Charles Howard, containing two squadrons; a squadron under himself with Sir John Hawkins, as Rear-Admiral of 17 Royal and 52 merchant ships (chiefly victuallers), and a squadron under Sir Francis Drake, as Vice-Admiral of 6 Royal and 34 merchant ships. This fleet was stationed at Plymouth. The other fleet was under Lord Henry Seymour and consisted of 12 Royal and 52 merchant ships, of which 23 were furnished by the Cinque Ports, and the remainder by the City of London. This fleet was stationed in the Downs.

The Royal ships averaged about 300 tons, 14 guns, and 140 men; the largest, the "Triumph" (Sir Martin Frobisher), had 1,000 tons, 40 guns, and 500 men. The merchant ships averaged about 130 tons, varying from 30 to 400 tons, of which about half were above 80 tons.

Thus it will be seen that although the total number of vessels employed on the English side was greater than that of the Spaniards, the tonnage was little more than one half, and the number of men and number of guns were not more than one half of the adversaries. The English ships had the advantage of having a fewer number of persons on board each ship, and that a much greater proportion of that number were efficient seamen.

[1] Estimated only.

Composition and Strength of Naval Forces.

The composition of the English fleet and its strength compared with population, deserve consideration. The total tonnage of all kinds gives about one ton to every 140 of the then population of England. The tonnage of the present ironclad fleet of Great Britain gives about one ton to every 80 of the population. The number of men on board the Royal ships was about $\frac{1}{750}$th of the population. The numbers included in the Naval Estimates, now-a-days, are altogether about $\frac{1}{520}$th of our population. The total number of adult males in the seafaring professions of that time, judging by an estimate made in 1572, must have been (including the Royal Navy) about 22,000, or about $\frac{1}{200}$th of the population. The number of adult males in the present seafaring professions (including 60,000 in the Royal Navy)[1] is about 350,000 or about $\frac{1}{90}$th of our population. Thus the fleets, both Royal and mercantile, and the whole marine of the country were small for their day, as compared with our time. The remarkable point is the very large proportion of this small marine, that was available for the defence of the country. The men in the Royal ships were about $\frac{2}{7}$ths of the seafaring men, and the whole number employed was about $\frac{5}{7}$ths of them. If we take the former of these to represent the peace establishment of the Navy, that proportion would give us now about 100,000 men, in place of the 60,000[1] we annually provide for. And if we take the latter to represent the war establishment, that proportion would give us 250,000 men. During the great war with France, at the beginning of this century, we employed nearly 150,000 men in the Navy; and I believe it has been estimated that we should now require at least double the strength of our peace establishment on an outbreak of serious war.

There were two modes at that time, in which the mercantile marine could be brought in to assist the Royal Navy. The first was by the impressment of sailors; that is to say, it was then understood that every man in the country was liable to be called upon to assist in the defence of it, either in the Army or in the Navy. This practice was used at the time, because the pay in the Royal ships was not sufficient to attract the mercantile seamen, except when a prospect of booty wasadded to it.

The second mode was the requirement from certain of the port-towns of quotas of ships and men to be furnished by them in war time, as a return for special commercial privileges granted to them. Thus we see that at sea, as on land, the principle was that as the wealth of the country increased, those who gained the chief profit should be prepared to defend what they had got by their enterprise. We have lost the idea of that principle, and have only kept the power of impressment in its most obnoxious form; and thus it has come to pass that with the greatest sea-commerce the world has ever seen, we have no system of securing it against a rival power, except by a costly permanent war fleet; which, though very expensive in peace, is quite inadequate for the demands of a serious war.

It is also remarkable how, in that spring-time of British commerce, all those demands on the lives and property of the sea-merchants, seemed only to rouse the enthusiasm of all to a pitch beyond what was

[1] This number includes persons of all classes, and the Royal Marines also.

required of them. The port-towns not only supplied vessels beyond the quotas asked, but private persons equipped and themselves brought ships to the support of the admirals. The spirit of the people having been preserved and organised, rose equal to the great occasion. The action of the English at sea, at that period, may be fairly compared to the deeds of Greece at Salamis. The English, like the Greeks, virtually took to the sea with their whole available maritime force, and their spirit was an earnest of their ability to do the work before them. The tone of all the letters is like that of Nelson and his sea captains; exultation at the opportunity of at last having a good fight with the great rival; a clear perception of the difficulty, but also a resolute mind to meet it, and a confidence in their intimate knowledge of the ships they were to fight in, and the sea they were to fight on.

As was said in the *Times* the other day, commenting on the works of that gifted and patriotic writer who died last month,[1] "It was well "for us that English commercial enterprise took that form in the days "of Queen Elizabeth. Had these Devon gentlemen stayed at home "tilling their paternal acres; had Hawkins, Forbisher, and Drake, con- "fined themselves to coasting voyages in the narrow seas, the story of "the Armada would have ended differently, in spite of the elements; "and in place of being mistress of her vast Colonial Empire, England "might have seen herself a province of the House of Austria."

Construction of Ships.

With respect to the size and construction of the vessels, the opinion of the experienced sea-captains of the time was generally in favour of the smaller and handier English vessel. "Grande navis grande fatica," says Sir Walter Raleigh. Lord Howard calls his ship (the Ark Royal, 800 tons), with evident delight, "a little odd ship for all conditions." When the adventurous mariners of England took to the great ocean, they were obliged, no doubt, to give up the galley, from want of labourers for the oars, and to use small sailing-vessels manned by a few very good seamen; and to compete with the great Spanish galleons, they had to be quick and handy. This suited their genius, and they and their ships became famous together; but we must not assume that the smaller size was deliberately selected for a great naval war. Indeed, the English seem to have been quite as much behind hand in the theory of shipbuilding then, as they have been almost ever since; and to have borrowed their ideas from the Netherlanders. Lord Howard's first demand after his first engagement with the Armada was for larger ships; and, as we have seen, Sir W. Monson preferred larger vessels and a proportion of galleys for sea-fights. The whole of the vessels of that period of all nations, apparently, carried so much top hamper as to be obliged to give up a large part of the hold to ballast; hence the number of attendant victualling ships; the victualler was to them what the collier is to a modern squadron, and gave the limit of their cruizing power. This was also limited by the unwholesomeness of the vessels after a short time; the number of men put *hors de combat* by this cause was a very serious loss both to the English

[1] The late Canon Kingsley.

and Spanish fleets, but more so to the latter on account of their crowded state. Otherwise the English ships appear to have been very well built, as far as the workmanship was concerned, and cheaply.

The armament of both Spanish and English fleets was probably alike in point of size of guns. Sir W. Monson gives a list of the guns in use, and says that demi-cannon ($30\frac{1}{2}$ lbs. ball, carrying 170 paces point blank) was the largest gun commonly used on board ship. Sir W. Winter mentions culverins ($17\frac{1}{2}$ lb. ball, 200 paces P. B. range) and demi-culverins ($9\frac{1}{2}$ lb. ball, 200 paces P. B. range); and, after the second day's fight, Medina Sidonia sent off an express to Parma for 4, 6, and 10 lb. balls. The ranges of the guns given by Monson should be borne in mind in the account of the fighting; some of the English guns being, no doubt, of good iron construction may possibly have been better shooting guns than the bronze pieces of the Spaniards.

Government Delays.

The Royal drag had not, therefore, the same effect on the wheels of Neptune's car as it had upon the chariot of Mars. It was felt, however, and produced quite as much noise. Hawkins wanted to cruize off Spain, but the expense (£2,700 per month) was too much for the great Queen. What a Chancellor of the Exchequer she would have made for these days! Lord Howard complains, in March '88, that Sir F. Drake's squadron is not allowed to be completed, and that some of the large men-of-war are kept lying idly in the Medway at Chatham, "to defend the church there," he supposes: "sparing and war have "no affinity together." "Money and jewels will not redeem the "time." And he includes Lord Burghley among the economists. "I "pray we do not curse, for this, a long grey beard with a white head "witless." Mr. Puff was apparently right when he called on Lord Burghley to shake his head as if there was something in it.

There were alternate panics and fits of economy worthy of the most peace-devoted government of commercial days. Even in the beginning of 1588, when we know Philip was hoping that Parma was already in England, the fleet was much dismantled, and many seamen allowed to go; and immediately afterwards they had to be refitted at a greater expense, and an inferior lot of men taken to replace those who had gone to seek employment elsewhere. Then, at a time when the goodwill of the sailors was of so much importance, the rations were reduced, and issued monthly, with such delays, that the fleet was short of food during the whole operations. It appears as if the Government of England, at the time, was unable to realise the crisis, which we can see now was occurring in the fates of Spain and England; that the former, if not checked, would inevitably continue her course of aggrandisement, and swallow up first Holland, then England; and that the latter was at a point in her existence, at which the people were both prepared and able to rise to the occasion, and gain a new footing in the world in fair fight.

One can hardly believe it possible that such infatuated economy existed in those great days, but we have an instance in our own days of the deliberate blindness of a Government in like case. In 1858, when

there were rumours of war in the political air, the Royal dockyards of England were allowed to get reduced into such a condition that if the whole force of them had been put on the work of fitting out the vessels lying in harbour for war, irrespective of building new vessels and of chance repairs, it would have taken two years to do the work.

A list of the whole of the Royal ships mentioned in Bruce, as having been employed on this service, is appended, and in it will be seen several well-known names in the British Navy. If any record were to be put up in this Institution of the historical deeds of the Navy, I do not think that there could be any names more worthy to commence the list with than those of the captains of these ships. And of all those names, many of them renowned in the world, I feel certain that there could not be a nobler one to head them than that of Lord Charles Howard. A nobleman of England and a Catholic, he sacrificed his feelings and his ease, and, without hesitation, drew the line between his adherence to his faith and his allegiance to his sovereign. Throughout the whole proceedings he shows the high-minded honesty of an English gentleman, coupled with a skill and gallantry worthy of the best days of British seamen.

Preparations in the Netherlands and in Scotland.

We must not omit the preparations made by the United States of Holland towards counteracting the Armada, for, without them, the junction between it and Parma would have been effected, and that great commander would have made a much more vigorous effort to land his troops in England. In the autumn of 1587, as soon as Parma had taken Sluys, they blockaded that port, and Newport and Dunkirk; and, by April, 1588, they had 90 war ships and 50 merchanters, varying in size from a gunboat to 1,200 tons employed on this service. The large square-rigged vessels were stationed between the Flemish Coast and England, those of smaller size lay within the banks off the former, and the sloops and flyboats lay close in-shore. The admiral of Holland was Warmond, and the admiral of Zealand was Juan de Nassau. These fleets, it will be seen, played an important part not only in blockading Parma, but in assisting to secure the results of the victory gained off their shores. And even after the great Armada had disappeared into the North sea, the danger that was still apprehended from Parma (so great was his renown) was so felt, that the English admirals showed great anxiety to get back to the Flemish Coast to watch him.

Neither must we omit to record the part played by Scotland. The young King James had been personally doubting which side to take, but the mass of the people of Scotland settled the question for him, by showing, unmistakeably, like the English people, their determination to adhere to the Reformed religion. In 1586, King James made a definite treaty of mutual defence with Elizabeth, in case of invasion of either country. Nevertheless, in June, 1587, Philip spoke of a simultaneous invasion from Scotland, when the Armada should appear by troops in his (Philip's) pay; but these were apparently to be furnished by the nobles of the Catholic party in Scotland. It, however,

so far affected the arrangements in England that the militia forces in the northern counties were all kept there.

Cost of the Naval Preparations in England.

We have got considerable data on the subject of the cost of the fleet, in the accounts of Sir J. Hawkins, the controller (who appears to have had as sad times under the Tudor sovereigns, as ever a controller of the present day had under the most economical Government). But there is a difficulty in determining the whole cost of the naval preparations during the year in which they were expecting the Armada; because the Queen, in her anxiety to save expense, ordered ships into harbour as often as she could, and the crews were either paid off or put on reduced rates, and the bulk of the expense of the merchant ships fell on the seaport towns which furnished them, or on private individuals. Sir J. Hawkins gives a statement of all the expenses paid by him for the eleven months, from 1st November, 1587, to 30th September, 1588, for H.M. ships, coasters, and volunteers, over and above the charges borne by the seaport towns and others, and not including victuals. This was £77,295, of which about £24,000 appears to have been spent on merchanters. In Bruce, there is an estimate of the cost of victualling H.M. ships and others for 18 months, from 1st July, 1587, to 31st December, 1588, which was £66,331, of which about £20,440 was for merchanters. From these two accounts the total cost of the 34 Royal ships, during 12 months, would have been about £90,000.

For estimating the cost of the merchant ships engaged, we have the following data:—The tonnage paid by the Crown to the owners, was at the rate of 2*s*. a ton per month, which, for the 20,000 tons employed, would be £2,000 per month. The wages of the seamen so employed were 14*s*. a month, and their victualling was estimated to cost as much more, so that the 9,000 men employed in the merchant ships, at 28*s*. per head, would have cost per month £14,600. Now whatever proportion the Queen paid, the owners of the merchant vessels would have had to incur the balance of the expense to make up that amount. Therefore it is fair to assume that the cost to the country during the twelve months could not have been less than £175,000 for the merchant vessels, and £90,000 for H.M. ships, or about £260,000 altogether. And if we take the purchasing power of money in necessaries of life to have been in 1588 six times what it is now, that amount would be equivalent to about a million and half pounds, and this fell on a population of about ⅛th of the present population of Great Britain, and consequently would be the same to them, as if we expended £12,000,000 in one year. The cost of the effective services of our War Navy at present is about £8,000,000 per annum.

Cost of the whole Naval and Military Defences in England.

Thus we see that the people of England had made arrangements for the defence of their country, which would have involved an expenditure for army and navy in the course of twelve months of a sum which would be equivalent to about £90,000,000 at the present day,

which is more than the cost of our naval and military forces in 1813—the most expensive year of the great war with France—and double the cost of the Crimean war in 1856.

THE ATTACK AND THE DEFENCE.

The plan for the invasion of England, originally proposed by Parma and finally adopted by Philip, was virtually the same as that of all other intended invasions of this country, since England was one united kingdom: namely, to land the main body of the invading forces as near to London as possible, and to make straight for that city. But to carry out this plan in this case, it was necessary that the naval part of the expedition from Spain, should first clear the seas of the hostile fleets, before the military part from the Netherlands could venture to cross over. Philip does not appear to have realised the probability of a great naval action; his idea was to effect the junction without the knowledge of his enemy, and so to take England by surprise. This involved the dangerous expedient of passing with his fleet along the whole south flank of his enemy's position; an operation which looks impracticable with a force like the Armada, in those days of slow sailing vessels; Sir W. Monson, however, says that if they had followed Philip's orders, they might have got to Calais in time to defeat the Dutch fleet, before the arrival of the English fleet, and so to have embarked Parma's forces. As it turned out, it was precisely this scheme of secret combination of the two parts of the expedition which ruined it. Had the Armada come the year before, when the Queen and Burleigh were writing official reminders to the Lords Lieutenant, this plan would probably have succeeded.

Philip's original idea appears to have been three or four simultaneous invasions; one in Ireland, the Armada in the Isle of Wight or some western port, Parma on the east coast, and a force from Scotland.

The report in England (according to Stowe, and probably spread by Philip) was, that a French force was to be landed in the west, Parma in Kent, and another force in Yorkshire. The Queen must have well known that France was in no condition to assist in such an undertaking. This plan of Philip's would have had a good chance of success, provided the whole expedition had been previously arranged for it; as it was not so arranged, Parma objected, and Philip so far yielded, that it was settled, that after Parma's force had landed, and succeeded (of which they had little doubt), the Armada was to return and take the Isle of Wight, as a stronghold, and after that to proceed to Ireland.

There was a very fair prospect of success, from the Spanish point of view. Parma had obtained information about England, and had selected the neighbourhood of Deal for the landing place, and the time after harvest, because of the fertility of Kent and the unwarlike character of its inhabitants (there was a greater force of horse and foot raised in Kent, than in any other county); there were no fortified cities in England as in the Netherlands, and London, even then remarkable for its wealth, was altogether defenceless. It was long

since the English infantry had appeared with success on the battle fields of Europe, and altogether there was little expectation of a defence like that the Netherlands had made. The fault of the failure in this promising programme lay not in his calculations and preparations.

Sailing of the Armada.

On the 30th May, 1588 (new style, which will be followed throughout), the Armada at last cleared out from Lisbon. The character of their movements is well illustrated by their having waited a month for a fair wind, and then being three weeks in reaching Cape Finisterre (300 N. miles). Then they were dispersed by a storm, which proved the inefficiency of some of the ships: of the four great galleys, one foundered, and two were captured by the slaves on board, led by a Welshman of the name of Gwynne, who must be recorded as one of the heroes of the Armada time. The fleet sheltered in Corunna Harbour (called the Groine by the English), and were so injured and had so many sick, that it was the 22nd of July before they put to sea again.

The instructions issued to the fleet by the Duke of Medina Sidonia (given in Bruce), show a religious zeal, but a military martinetism quite unsuited for a naval expedition.

The English fleet lying at Plymouth, appears to have been remarkably deficient in intelligence as to the movements of the enemy; which may be partly accounted for by the Queen's refusal to allow men of war to cruise off the coast of Spain. They had been ordered to cruise in "the Sleeve," as they then called it, against the advice of the Lord Admiral: provisions were the turning point of a cruise then, and what the Lord Admiral feared most, was meeting the Spanish fleet when he was short of them, and he even thought it would be part of their plan to starve him out of the way. This is what would occur now, substituting coal for provisions. The last they heard of them was their being driven in "the Groine" by the storm; the Queen heard of this too, and characteristically ordered some of her war ships to be immediately dismantled; an order the Lord Admiral fortunately delayed to execute, as he almost immediately heard of the arrival of the Armada at the Lizard. There is a fine letter from Lord Howard to Secretary Walsingham, of July 6th, showing his noble and sailor-like character; after discussing in good seamanlike style, the *pros* and *cons* of the case, he finishes with, "we must proceed by the likeliest "ways, and leave unto God to direct for the best, and so I bid you "heartily farewell.

"From on board Her Majesty's good ship the 'Ark,' the 6th day of "July, 1588.

"From your assured loving friend,
"C. HOWARD."

It turned out that what they had been doing was for the best; for the Spaniards at Corunna were also deceived by a report that the English fleet had been dismantled in Plymouth Harbour, and by the advice of De Valdez, their best sailor, Medina Sidonia determined to

disobey his orders, and attack the English fleet in harbour; for which Valdez was afterwards imprisoned for life. They would, however, have succeeded in surprising Lord Howard in harbour, but owing to their ignorance of the English coast, they mistook the Lizard for the Ram's Head at Plymouth, and stood off for the night, intending to enter in the morning. By this delay Lord Howard had had time to warp his ships (60 in one night) out of the Catwater where they then lay; and to the disagreeable surprise of the Armada, as they came along the Cornish coast on the afternoon of Saturday, the 30th July, about 15 miles west of Plymouth, they found some 70 English vessels ready to receive them.

What a night that of Friday, the 29th of July, 1588, must have been in England: when the thought of it warmed the philosophic Macaulay into patriotic verse:—

> It was about the lovely close of a warm summer day
> There came a gallant merchant ship full sail to Plymouth Bay;
> Her crew hath seen Castille's black fleet, beyond Aurigny's isle,
> At earliest twilight, on the waves lie heaving many a mile.
> Night sank upon the dusky beach, and on the purple sea,
> Such night in England ne'er had been, and ne'er again shall be,
> From Eddystone to Berwick bounds, from Lynn to Milford Bay,
> That time of slumber was as bright and busy as the day;
> For swift to east and swift to west the ghastly war-flame spread,
> High on St. Michael's Mount it shone; it shone on Beachy Head.
> Far on the deep the Spaniard saw, along each southern shire,
> Cape beyond Cape in endless range, those twinkling points of fire.

The running Fight in Channel.

And now we come to that remarkable running fight which lasted nine days and extended over 400 miles; but I am not going to attempt a detailed description of this tournament of ships along the coast of England, when there exists so admirable a picture of it in that charming book "Westward Ho," and such full accounts of it in Mottley and Froude. There are, however, some points about it, which are, I think, worthy of attention in these days of discussion on naval tactics; a fleet of comparatively small ships, over that time and distance, got the better of one of large ships, by artillery at long range. And this was done, not by construction or armament, for these were generally the same in both fleets, but by three qualities; swiftness and handiness of the ships, and good seamanship. There are some reservations to be made in the first part of this long fight, but the great final battle appears to me to teach a clear lesson about guns, as I shall point out when we come to it.

The Spanish fleet sailed in what Admiral Monson calls "the proportion of a half moon," the centre advanced, the wings thrown back; the Admiral in the centre, with the Rear-Admiral behind him, the great galleys and galleasses on the flanks. As there was no sailing close on a wind in those days, the orders were simple; no ship was to go a-head of the Admiral, or astern of the Rear-Admiral: Hakluyt, speaking of their good order of sailing, says they were "three or four "in a rank," following close up one after the other; and Camden says

they stretched seven miles; this agrees with the drawings in Adam's and Ryther's book. And in this order they advanced slowly along the coast of England, before a S.W. wind and a smooth sea, such as one expects to find in the channel in August. The Duke of Medina Sidonia, after finding out his mistake about the English fleet, resolved to make straight for his rendezvous at Calais without stopping for anything. The English fleet would have got to close quarters and boarded, if they had dared; but the Spanish vessels were too high to run such risks; and Lord Howard knew well that the issue to England depended mainly on his thirty ships of war. So he let the Armada pass, and kept behind, that was to windward, and ordered that his ships should not allow themselves to get closer to the enemy than good cannon range, 200 to 400 yards. Divided into four independent squadrons, they carried out this idea so well, that even, when by a slant of N.E. wind the Spaniards got the weather-gage, they could not close upon any English ships: and the Spanish Admiral was obliged to place his best galleys in the rear to cover his progress.

The Spaniards describe the English fleet, during the progress in the Channel, as sailing along the rear of their line, firing into their vessels in succession, and that they in vain attempted to get alongside of them by crossing their courses. They mention particularly the Flag ship, the "Ark Royal," which, the wind being at the moment easterly, had run into a Spanish vessel and damaged her own rudder, and yet, before another Spaniard could close upon her, she got her head pulled round by her boats and sailed away from them. They were also astonished at the quick firing from the English guns, which they say was four to one of their own.

I said there were reservations on this part of the fight. Firstly, the Spaniards could not manage their own ships; they repeatedly fouled each other, and their losses in the Channel were almost entirely occasioned by the English capturing their ships damaged and left behind by their own fault in this respect. Secondly, very little damage was done on either side by the firing, although each side fired away the greater part of their ammunition. This was partly bad gunnery; the master gunner of the English flag ship (who corresponded direct with the Secretary of State), was as angry as if he had been director of the gunnery ship of the day: and some of the Spanish guns were so high (in their castles) that they could not depress them sufficiently to hit the low English hulls. Thirdly, neither side was satisfied with the result: one can understand the Spaniards being dissatisfied and sending off express to Parma for "fly boats," to chase the English ships; but it is curious to find the English Admiral also sending off express to his Government for larger ships to board the Spaniards with. He was gaining a victory without knowing it.

An episode occurred at this time, illustrative of the importance, even in those days, of having a war harbour about Dover. Lord Henry Seymour, who commanded the squadron stationed in the Downs to assist in watching the Flemish coast, came westward as far as Dungeness on hearing of the arrival of the Armada. But, running short of provisions, and hearing nothing more, though the Armada

must have been almost in sight, he returned to the Downs on Saturday morning, August 6th; and before he could revictual, he received orders to join the Lord Admiral off Calais. Now if the Spanish expedition had been arranged so that Folkestone had been one point of debarkation, it would have been effected before Lord Henry could have arrived to assist in preventing it; for the wind was so light, that it was evening before he joined the Admiral.

The Anchorage at Calais.

On Saturday evening, August 6th, 1588, the two hostile fleets anchored off Calais, within one mile and a half of each other; about 130 vessels in the Spanish fleet, and 140 in the English; the Spanish fleet to the westward, in the more sheltered position. And there they lay all Sunday. Perhaps no British Admiral before or since has had so important an issue resting on his shoulders, as Lord Charles Howard had that night: the fate of England depended on his action. The enemy were still virtually intact; they had steadily pursued their course in spite of the English fleet; and after their junction with the Prince of Parma (of which neither side had then the smallest doubt), that fleet would be still less able to stop these mighty ships from crossing the short distance further to the English coast; and if they once landed there, the Lord Admiral knew there was little to oppose them. Little did he imagine that the mind of the Spanish Admiral was equally filled with doubt as to his next move.

Whether from natural incapacity, or jealousy of the rival commander, Medina Sidonia does not appear to have contemplated the idea of forcing his way up the Scheldt to effect the junction; he expected Parma to come to him. Parma set to work with great energy and got 16,000 men (all that was left of the 30,000 of six months previous) on board his transports at Dunkirk and Newport, but he could not move out in face of the Dutch fleet. Thus were the two component parts of this mighty expedition, lying within thirty miles of each other, each waiting for the other. There was still great enthusiasm and spirit among the Spanish forces, though there was, no doubt, some fear of the English seamen. There also was lying the English fleet, animated with equal spirit and greater confidence, but yet not daring to attack the tall galleons filled with men, while they were at anchor; if they had had equal sized ships, they would, no doubt, have anticipated the tactics of the battle of the Nile; as it was, the only question was, how to force them from their anchorage before Parma could join them. A modern naval tactician would have been only too happy to have got such an opportunity of bringing his rams and torpedoes into action. There were no vessels suitable for ramming in the English fleet, but the torpedoists will be gratified to know that that weapon was virtually brought into play, and with remarkable success.

Sir William Winter (then apparently a Commissioner of the Navy) came on board the Lord Admiral's ship to give his advice under the circumstances, and then saw the great Armada for the first time: "and having viewed the great hugeness of the Spanish Army, did

" consider it was not possible to remove them but by a device of firing " of ships, which would make them leave the only road which was " meetest to serve their purpose." And in the middle of Sunday night—a dark, cloudy night, with flashes of lightning—the Spaniards suddenly beheld six fire-ships coming down before the wind and tide upon them, all ablaze. Fire-ships alone were well-known expedients, and might have been met without endangering the existence of the fleet; but, not long before, an Italian engineer had employed against the Spaniards in the Netherlands some kind of floating torpedoes, which, coming down the Scheldt at Antwerp, had blown up a floating bridge and some vessels, and many men. This was well known in the Armada, and it was also known that the Italian engineer was then in England, and these fire-ships were supposed to be of his invention. A panic seized every ship in the fleet; Medina Sidonia in vain attempted to preserve order; before morning, the whole Armada had cut their cables and got under way. Gianibelli, the engineer, must also have a place among the victors of the Armada.

Once more, then, the great line of the Spanish fleet is going before a fresh south-west wind up the deeps of the Channel, between the Goodwin Sands and the coast of Flanders. But the gallant, though incapable Medina Sidonia, exasperated against Parma for, as he thought, deceiving him, now resolved to act for himself. He reformed his line and when the English fleet came up with them again, he turned, and the great decisive battle between England and Spain at last took place.

The Battle off the Goodwins.

About 8 A.M. on Monday, the 8th August, 1588, the fleets neared each other. Lord Howard had determined his plan of attack, in three independent squadrons; but this was upset by his remaining behind to assist some small vessels, whose boats were capturing a great galleass, which had grounded at Calais; so the impetuous Drake had the opportunity of leading his squadron against the centre of the Spanish line, in which he was followed by the equally pushing Frobisher and Hawkins. Lord Henry Seymour and Sir W. Winter attacked the starboard wing.

This was a real battle of guns. The English necessarily adhered to avoiding being boarded by the Spaniards, and kept at musket shot, that is to say, probably not exceeding 200 yards; it is difficult to understand how they avoided it, as they speak of being surrounded by these great galleons. The Spaniards must have been dispirited and the English inspirited by the night before; for the wing attacked by Winter ran into the body of the fleet, and fouled each other; and the small English vessels remained thus firing on all sides for eight hours. Winter says he fired 500 shot, which, as he had 30 guns, would be 25 rounds a gun. By 4 P.M. the Spaniards had suffered considerably; all their best ships were injured in their hulls and rigging, three large ships sunk, two or three others drifted on shore or into the clutches of the Dutch fleet; one ship is said to have had 350 shot in her, another was shot "through" six times. Strange to say, the English fleet

suffered comparatively little damage; there is no mention of one single ship being put *hors de combat*, and not 100 men killed, whereas the Spaniards lost more than 4,000: Drake's ship was pierced by 40 shot. The height of the Spanish guns above the water will probably account for part of this difference of injury, but still they carried guns in their waists, and we must put it down mainly to the superior skill and confidence of the English seamen.

At 4 or 5 P.M., Medina Sidonia was warned by his pilots that he was drifting on the dangerous lee shore of Flanders, with an increasing wind from more to the northward, so he made sail away to the N.N.E., evidently unwillingly, for he retreated in good order. The English were not loth to stop either. Winter says, "When every man was "weary and our cartridges spent, we ceased;" and says Lord Howard, "We put on a brag countenance, and followed the enemy." They must have felt that they had won, but they did not know how great a victory it was; how serious a battle both sides thought it, may be judged from Lord Howard: "Some make little account of the "Spanish forces by sea, but I do warrant you, all the world never saw "such a force as theirs was; and some Spaniards taken say, it ex- "ceeded Lepanto." But neither side as yet realized that that day's fight had settled the question of the command of the sea for many years.

Now the question I would put to naval tacticians of the present day is, whether such a fight is possible with ironclads? Is it practicable to build an ironclad of comparatively small size, and which shall nevertheless carry a few of the largest guns, and yet be swifter and handier than what we may call the line-of-battle ironclads? For if is possible to construct such a vessel, it seems that they would be able to make a fair fight against the larger vessels at long range. The tactics adopted by the English fleet against the Armada were quite different from the ordinary practice of the time. The guns were then considered so inferior to the ships, that in all naval actions the object of the attacking fleet was to get alongside as soon as possible, and determine the issue by the personal combat of the fighting men on board. The battle of Lepanto was so fought. The English fleet would have gladly followed the usual system, had they dared: they adopted the other plan in desperation of the circumstances. The remarkable thing about it is, that it entirely succeeded, and its success equally astonished both sides. It is true, the Spanish ships were unwieldy and badly handled, but they were manœuvred during the battle, and with great gallantry and some effect. It was really a question of the comparative manœuvring power of the two fleets, as well as of their seamanship and gunnery.

Now, let us consider the difference between guns and ships at that time and at the present. The gun was evidently then really superior to the ship, if guns and ships were properly handled. So much was this known to be the case, that the guns continued much the same for two hundred years after, while attention was turned to improving the ships. And this went on until, in Nelson's days, the ships became again more powerful than the guns, and the plan of battle again was

to get alongside. Then, in our own day, the guns took a start, but the ships almost immediately counterbalanced the improvement by the adoption of armour-plating; and, just now, we find naval tacticians recommending rams and attached torpedoes, showing that they consider the ship to be superior to the gun. No person can venture to say, at the present moment, to what extent the use of iron in ships and guns can be carried, or that we have arrived at the ultimate speed of ships. But there is this point to be considered—ships have apparently arrived at a resting-place, and are large vessels with slow manœuvring power, whereas the gun is still advancing, not only in size, but, what is equally important to the question, in facility of working. The size of ships has increased five-fold since the Armada; the size of guns has increased twenty-fold; there are fewer of them carried, but each is more effective, and is likely to become more accurate and quick in firing.

This is an important question for us, for if there is a possibility of the gun becoming again superior, it will evidently be to the advantage of those maritime nations which cannot afford large ironclads, to be able to use small, quick, handy vessels, at long range, with a prospect of success. And, in such case, it would be necessary for a great maritime power to have a proportion of such vessels to match them. This would not dispense with the necessity of having the larger vessels as well; but they would be reserved for grand maritime warfare; that is to say, a war for the command of the sea, which can only be settled in too ways—either by great naval actions or by the invasion and conquest of one of the powers.

The Great Storm.

The story of the subsequent proceedings of the Armada is interesting to us, as exhibiting the superior seamanship of the English, acting, as it were, in spite of the economical tendencies of the Government. Medina Sidonia made another gallant attempt to face his pursuing foe, but, owing to the faulty navigation and seamanship in his fleet and to the adverse heavens, it only resulted in the whole Armada being nearly stranded on the shoals off the mouth of the Scheldt. Then he appears to have lost spirit, and to have had thoughts of surrendering altogether. It is true that he had many sick and wounded on board, many of his vessels were disabled, his men discouraged, and his pilots ignorant of the sea they were entering. But one has only to consider the condition of the English fleet he was flying from, to learn the true cause of the failure of the expedition. Hawkins writes, on August 11th, still much afraid of the Armada, "has no victual, money, "powder, or shot; men have been long unpaid;" Lord Howard, on the 17th, "powder and shot well nigh all spent; made for the "Forth to refresh our ships with victuals, whereof most stood in "wonderful need." Yet they followed the Spaniards (out of gun shot) up, to 55° 13′ N. lat., where they left them on the 12th August; but only to refit, still expecting their return—still expecting the terrible Parma to burst forth from the coast of Flanders, for, says the humble-minded victor, "I long to do some exploit on their shipping." Then came the

great storm, like the final judgment of Heaven on the undertaking; for it was not only a most unusual event to happen in August, but the bad weather lasted all through August and September; and though the English fleet was exposed to the first burst of it, they did not lose a ship. They re-assembled at Harwich, only to find that their economical Government had made no preparation for their sick and wounded, not even for the pay due to the seamen; and to receive, in reply to their earnest request to go to sea again, such wise official reflections from Lord Burghley as these:—"To spend in time convenient is wisdom; "to continue charges withouth needful cause bringeth repentance."

And yet, at that moment, the Armada still consisted of upwards of 100 ships, and if they had gone to Denmark to refit, as some expected, they would still have been more than a match in material strength for the English fleet; and at that moment Parma had still his 16,000 men fully equipped. When one reads, in "Froude's History," of the Spanish ships strewed along the coast of Scotland, and of whole fleets and armies wrecked in Ireland, and of still a remnant returning to Spain, one cannot but acknowledge, with Mottley, "that the danger "was at last averted, is to be ascribed to the enthusiasm of the British "nation—to the heroism of the little English fleet—to the effective "support of the Hollanders—and to the tempest;—very little credit "is due to the diplomatic or military efforts of Elizabeth's Govern-"ment."

CONCLUSION.

The spirit of a nation lies in its aristocracy, but its strength rests in the people.

If this is true, the story of the Spanish Armada teaches a lesson to statesmen in peace as well as war, for the English nation, then of little repute in Europe, showed both the will and the power to maintain their independence against the strongest, and a capability of doing something more than that. And this was not owing to unlimited freedom in trade or in person or in politics, but, as far as it was due to human foresight, was mainly the result of laws having the special object of regulating each person's position and duties in civil life, from highest to lowest, and which were executed by men in authority, who felt and were not afraid of their responsibility.

But if we take into consideration the possibility of war, the statesmen responsible for defending our empire may learn the further lesson from this episode in our history, that *one of the greatest securities for the independence of these islands is in a very large and well organized Militia.* If that little nation of Englishmen, imperfectly armed, could determine to defend their shores against a greatly superior foe, how much more should we be able now to make them impregnable? We have five times the population, two or three times the wealth per head of that population, and the most perfect weapons in the world, to defend the same length of coast-line. If we multiplied our Militia by ten, and paid them at the highest rate of labourers' wages while in training, we should be doing no more than those few ancestors of ours, who laid the foundation of all our

wealth. I am not saying that it is necessary to increase our military forces immediately, but that we have lost the organization which enabled them to do so; it is not in the numbers that the defect consists, but in the absence of the spirit of being prepared to hold our position in the world. What we want is, the will to sacrifice so much of our present wealth as they did, to ensure our security. Having got that will, we should have little difficulty in these days in arming and training them, so that every man would be capable of making the most of his weapon, and accustomed to some kind of discipline.

But there is a danger, in these days of refined organization, that we shall sacrifice real efficiency for the sake of official precision, by centralizing the administration and authority. Now, it hardly requires the record of those days to convince us that the one great characteristic of all the deeds of Englishmen is, the feeling of independent authority, and with it of responsibility; it is an essential mark of a free, God-fearing nation, and any organization that does not take it into consideration fails to touch the heart of the nation's spirit. But the story of the Armada shows, in a remarkable manner, how, on the one hand, the Kings of Spain, by concentrating all authority into one centre, stifled the individual enterprise of their people, to their own loss; and how, on the other hand, the good local organization of all ranks throughout the country in England produced success, notwithstanding the supineness of the central Government. It is in this point where I think the maxim of the old Chinese general is applicable. For, in our navy, that delegated responsibility and authority has always of necessity been more preserved than in our army. The Commander of a fleet or of a ship is necessarily, even in peace, in a more independent position and with a larger sphere of responsibility than a Commander of any military force. I advocate the application of the system to a greater extent in our army than has been the case for many years—a return, in some measure, to the principles of organization of former days, which were more in accordance with our national characteristics; and I would take this responsible authority low down in the ranks of officers; not only should the local Commanders of our military forces have greater power and greater responsibility in all things, but the Colonels of regiments and the Captains of companies should be allowed a greater field for the exercise of their capabilities in providing for and keeping up the efficiency of their men. This idea, it will be said, is very contrary to the doctrines of administrative economy and Parliamentary responsibility which have been taught for many years. I can only reply, in the words of the noble seaman whose fleet saved England from the Armada:—"Sparing and war have no affinity "together;" "I must and will obey; I am glad there be such there as "are liable to judge what is fitter for us to do than we here; by my "instructions I did think it otherwise, but I will put them up in a bag." I believe that, by striving after this formal precision in appearance—this concentrated responsibility—you lose what is of ten thousand times more value to the country—the stirring of the conscience of the real workers—the hearty feeling of a share in the power and responsibility of defending the empire.

The British proprietor, when he is organizing an establishment to carry out some private business of his own, seeks for men he can trust, and then puts entire confidence in them. But this is not the way in which they proceed in dealing with the business of the country; at least, of late years the idea has appeared to be, that the best security for the proper performance of it is to give local authorities as little power as possible, and to supervise that power with such an arrangement of checks as to take away almost all feeling of responsibility.

The one paramount lesson to be learnt by our war statesmen, from the story of the Armada, is the preservation of a race of efficient seamen. Our present seafaring population is far larger in proportion to the whole population, than it was in those days, but it is a question whether there are on the whole as large a proportion of efficient seamen among them. Then, every man who was a sailor at all, was of necessity a seaman, with a general skill in all the branches of his profession, which is more perfectly learnt with small vessels and a hazardous trade, and also of necessity having a knowledge of guns, and a resolute enterprising spirit. The parsimony of the Government prevented the employment of the best of them in the Royal Navy, but there was a large field to draw upon, and as we have seen, on emergency it was very largely drawn upon. And there was a more intimate connection between all parts of the naval service of the country, royal and private: from the nature of the ships, little alteration was required to turn a merchantman into a royal man-of-war; and indeed there was not very much difference in the operations of each; the prizes taken by the royal ships gave a better reward to the men engaged than any ordinary trading. It was, in fact, this fine prospect of fortune that made the seamen of those days; the harvest to be reaped even in the regular channels of commerce, was as tempting as blockade running, or any of our most lucrative lines of sea trade, and the prizes to be gained under a bold man-of-war Captain, were like gold diggings to the labourers of to-day.

There are no such premiums to offer in our day to enterprising seamen: the orderly government of the world and the use of steam are against these adventurous spirits, just as regular armies and arms of precision have done away with knight errantry; but there are still plenty of openings both on land and sea for enterprise for boldness and for skill; and there are still modes in which the seafaring population may be encouraged in their profession, and brought into connection with the higher duty of defending their country. There are confessedly improvements required in the interior economy of our merchant vessels, and in the condition of our sailors, and for the sake of humanity and for our trade, it will, no doubt, be the duty of the Government to interfere in these matters with a strong hand; I would advocate a more extensive interference, for the sake of the efficiency of British seamen, so that they may be raised to the highest status among the seamen of the world. There is at present, no connection worth speaking of, between the merchant service and the defence of our empire and its trade, and perhaps no such connection can be made, that will be really equal to the requirements of the times, without

trenching on the liberties and the profits of the shipowners and seamen of the country.

This question of the supply of efficient seamen has been given a startling interest this winter, by the representations of the Liverpool shipowners to the Government, of the deterioration of the British merchant seamen. And this conclusion has been arrived at, not by alarmist officers, but by patient and perfectly independent enquiry, by the commercial men most concerned in the matter. As a curious corollary moreover to the arguments I have been drawing from the story of the Armada, they couple with that announcement, an expression of the necessity for a better connection between the mercantile and the Royal Navy. Some think, and there are naval men of high authority who agree in this, that the deterioration dates from the time of the abolition of the Navigation Laws, and system of apprenticeship; but whatever the cause, all men who think seriously about the defence of their country, will agree with the shipowners of Liverpool, that it is a vital question for the existence of Great Britain. We appear to have been working for some years past on the idea, that the accumulation of private wealth by commercial enterprise, is an interest sufficient to govern the world; we seem now to be discovering, that owing to the many other conflicting interests in the world, this system fails even to govern itself; and that that country, which, like Great Britain, has devoted its energies to the realisation of the idea, has put itself very much at the mercy of those, who, not enjoying the same profits, but anxious to do so, have rival interests. Because, while the devotion to commerce has lasted, two elements of national vitality have been allowed to get into a dangerous condition. The food supplies of the people have become dependent on foreign countries, and the war spirit which should secure them, has fallen into decay. Spain would have had no occasion, now, to prepare a great Armada to invade England, in order to cripple that country; she would divert the attention of the British fleet by threats upon our colonial empire, while her cruisers intercepted the merchant fleets coming from America and Germany, laden with the food without which we can no longer exist. There seems, therefore, to be some necessity for a reconsideration of our position.

The serious question is, whether under the circumstances of the world in which we find ourselves just now, it is not indispensable for Great Britain to sacrifice some of the enormous wealth she is annually accumulating, to effect such a connection between the labouring population and the land defences, and between the seafaring population and the sea defences, as shall not only raise the numbers requisite, but shall rouse the spirit of the people, as those of our patriotic forefathers were roused, when they determined to sacrifice all they had, rather than let the country fall under a foreign yoke.

Great Britain is now somewhat in the position that Spain held in the days of Queen Elizabeth; the great maritime and colonial power of the world. The Government of England in those days, failed to appreciate the true position and future of their country; and the Government of England of late years, has not apparently fully appre-

ciated the position and responsibilities of the empire now: or they would have been more earnest in providing such an organization of the people by land and by sea, as would have ensured the fulfilment of our duties to our colonial dependencies, and would have prevented the alarms about the security of our trade, and even of our shores, to which we have been lately subject.

But there is another remarkable point of similarity between the two epochs. There are clouds appearing in the peaceful horizon that has surrounded these islands for half a century. We have been told by high authority, that the religious question in Europe is tending in directions that can hardly be settled peaceably; and a new power has arisen in Europe, whose aspirations after sea commerce are most likely to bring her into some sort of collision with the great maritime nation of the day. These aspirations may be perfectly legitimate, and may indeed be a necessity; just as it was indispensable for Spain to add Portugal and other maritime countries to her dominions, in order to carry out her mission in the rest of the world. But it is not the less a necessity for us to preserve the power placed in our hands by Divine Providence, for our mission in the world. Let us hope that if the political sky is once more overcast by these two ancient elements of discord, the Government of Queen Victoria will not, like that of Queen Elizabeth, trust so much to subtle diplomacy, and to the skill and devotion of the few soldiers and sailors in the Royal Service; but that, taking warning from that story, they will prepare the country well beforehand, so that we shall not be in danger of losing any of that dominion by land and sea, which has been growing under our hands, ever since those gallant English seamen defeated the Spanish Armada.

Detail of the English Land Forces.

Army to Encounter the Enemy on the Coast.

Counties.	Foot.	Light horse.	Lances.	Pioneers.	Total.
Cornwall	2,000	140	16	..	2,156
Devon	3,000	200	..	600	3,800
Somerset	3,000	340	50	..	3,390
Dorset	2,000	40	120	600	2,760
Wilton	2,000	300	50	..	2,350
Southampton	4,000	50	100	1,000	5,150
Berks	2,000	37	10	115	2,162
Sussex	4,000	240	20	1,300	5,560
Kent	4,000	330	64	1,077	5,471
Surrey	1,000	127	8	200	1,335
Total	27,000	1,804	438	4,892	34,134

Army at Tilbury.

Counties.	Foot.	Lances.	Light horse.	Total.
Bedford	500	17	40	557
Buckingham	500	18	83	601
Hertford	1,000	25	60	1,085
Surrey	1,000	8	98	1,106
Berks	1,000	..	..	1,000
Oxford	1,000	..	..	1,000
London	1,000	35	88	1,123
Suffolk	3,000	50	200	3,250
Essex	5,000	..	..	5,000
Kent	5,000	50	100	5,150
Norfolk	3,000	..	..	3,000
Total	22,000	203	669	22,872

The Queen's Guard.

Counties.	Foot.	Lances.	Light horse.	Petronels.
London	10,000	35	88	
Middlesex	1,000	35	88	
Northampton	1,000	20	80	
Oxford	1,000	8	120	
Gloucester	1,500	20	180	
Bedford	500	17	40	
Buckingham	1,000	25	119	600
Hertford	1,500	20	119	500
Cambridge	500	6	40	
Essex	2,000	49	250	300
Kent	2,000	..	..	300
Surrey	800			
Suffolk	2,000	70	230	300
Norfolk	2,000	80	695	300
Warwick	600	12	76	
Leicester	500	9	70	
Huntingdon	400	6	20	
Worcester	600			
Total	28,900	377	2,127	2,300

Total 33,704.

Remaining in Counties.

Counties.	Foot.	Counties.	Foot.
Bedford	500	Sussex	4,000
Buckingham	600	Wilton	2,400
Hertford	1,500	Cambridge	1,000
Surrey	1,872	Northampton	640
Berkshire	1,900	Leicester	500
Oxford	1,164	Warwick	500
London	10,000	Dorset	3,330
Gloucester	4,000	Suffolk	4,239
Somerset	4,000	Norfolk	4,000
Total	25,536	Total	20,609
Of which 6,000 to be ready to join at Tilbury.		Of which 17,600 to be ready to join Her Majesty's Guard.	

Summary.

	Totals of all kinds.
Army on the coast	34,262
Army at Tilbury	22,872
Queen's Guard	33,704
Reserve remaining in counties ..	46,145
Forces in Wales	9,377
Forces in Yorkshire and Durham	14,000
Grand Total.. ..	160,360

This total consisted of the following proportions:—

Foot ..	87 per cent.
Horse ..	4 per cent.
Pioneers	9 per cent.

The foot were about half of them trained and half untrained; and about one-third of the whole were furnished with fire-arms; the remainder with pikes, bows, and bills.

Of the horse, about three-quarters were light-horse, and of the remainder about half were lancers (or heavy cavalry), and half petronels (or dragoons).

Detail of the English Sea Forces.

List of the English Royal Navy engaged in the Defeat of the Spanish Armada.—August, 1588.

Lord Admiral's Squadron.

No.	Names.	Tonnage.	Guns.	Men.	Captains.
1	"Ark Royal"	800	32	400	Lord C. Howard, Lord Admiral.
2	"Victory"	800	32	400	Sir J. Hawkins.
3	"Mary Rose"	600	30	250	Finton.
4	"Bonaventure" ..	600	30	250	Reyman.
5	"Triumph"	1,000	40	500	Sir Martin Frobisher.
6	"Elizabeth Jonas"	900	40	500	Sir R. Southwell.
7	"White Bear"	900	40	500	Lord Sheffield.
8	"The Lion"	500	30	250	Lord T. Howard.
9	"Swallow"	330	16	160	R. Hawkins.
10	"Dreadnought" ..	400	20	200	G. Beeston.
11	"Tramontana" ..	150	8	70	L. Ward.
12	"Foresight"	300	16	160	Baker.
13	"Charles"	70	6	45	Roberts.
14	"Moon"	60	5	40	Clifford.
15	"Bonavolia" galley	*500*	*30*	250	W. Bourough.
16	"Teittari"	*200*	*12*	100	J. Bostock.
17	"Brigandine"	*45*	*4*	35	T. Scot.
		8,155	391	4,110	

Sir Francis Drake's Squadron.

No.	Name.	Tonnage.	Guns.	Men.	Captains.
1	"Revenge"	500	*30*	250	Sir F. Drake, Vice-Admiral.
2	"Swiftsure"	400	20	200	W. Fenner.
3	"Aid"	250	*15*	120	J. Wentworth.
4	"Hope"	600	30	250	Cross.
5	"Nonpareille"	500	30	250	T. Fenner.
6	"Advice"	50	5	40	J. Harris.
	Total........	2,300	130	1,110	

The tonnage, guns, and men in *italics* are only estimated from the other ships.

Sir Henry Seymour's Squadron.

No.	Names.	Tonnage.	Guns.	Men.	Captains.
1	"Rainbow"........	500	30	250	Lord H. Seymour.
2	"Vanguard"	500	*30*	250	Sir W. Winter.
3	"Antelope"......	350	16	160	Sir H. Palmer.
4	"Tiger"	200	12	100	W. Wentworth.
5	"Bull".........	200	*12*	100	J. Turner.
6	"Scout"	120	8	66	Ashley.
7	"Achates"	110	*7*	60	G. Riggs.
8	"Spy".........	50	5	40	Bradbury.
9	"Martin"	45	4	35	W. Gower.
10	"Sun".........	40	4	30	R. Buckley.
11	"Signet"........	20	*3*	20	J. Shirive.
12	"George Hoy" ..	100	6	30	R. Hodges.
	Total........	2,235	137	1,141	

Summary.

No.	Names.	Tonnage.	Guns.	Men.
17	Lord Admiral..................	8,155	391	4.110
6	Sir Francis Drake..............	2,300	130	1,110
12	Sir Henry Seymour	2,235	137	1,141
35	Grand total..............	12,690	658	6,361

The tonnage, guns, and men in *italics* are only estimated from the other ships.

Merchant Ships engaged in the Defeat of the Spanish Armada.—August, 1588.

		No.	Men.	Tons.
Under the Lord Admiral	Ships and barks, fighting ships, and victuallers	33	1,561	
	Coasters, great and small, paid by the Queen	19	943	
„ Sir Francis Drake..	Merchant ships..............	34	2,394	
„ Lord H. Seymour	Coasters paid by the Queen and partly by the Cinque Ports..	23	1,093	
	Ships and barks paid by the City of London...........	29	2,140	
Voluntary ships, great and small........................		23	939	
	Totals.....................	161	9,070	About 20,000

The average size of these merchant ships was 130 tons each, but they varied from 30 to 400 tons, of which there were about half above 80 tons.

LIST OF SOME BOOKS RELATING TO THE SPANISH ARMADA.

Bruce.—Report on the Spanish Armada, compiled for the Government, 1798: contains many of the original reports and letters on the English preparations in the State Paper Office, and is the source from which most late writers have obtained their detailed information.

Monson, Admiral Sir W.—Naval tracts, written in the time of Charles I: gives details of naval operations and discussions.

Hakluyt, Collection of Early Voyages, written in 1599: gives some account of both fleets, and of the operations.

Camden's Annals of the Reign of Queen Elizabeth; written by desire of Lord Burghley: contains some account of the whole affair, but not so full as might have been expected.

La Felicissima Armada, a Spanish account by Jacques Boullain, Lisbon, 1588: contains full details of the Spanish Fleet. (In British Museum.)

Expeditionis Hispanorum Angliam vera descriptio; Rober. Adams, Authore—A. Ryther, Sculpsit, 1588.—This consists of a map of England, and ten plates of the Southern Coast, showing the position of the two fleets each day. (Bound up with the last book.)

Survey of the Coast of Sussex in the time of Queen Elizabeth: reprinted by Mr. Lower, Lewes, 1870.

Barrow's Life of Sir F. Drake: quotes much from a Spanish MS. account, which appears to be in the Admiralty.

Froude's History of England from Henry VIII to Elizabeth, 1870: gives much detail concerning the condition of the people of England, and of the operations; rather favourable to the Spanish.

Mottley's History of the United Provinces of the Netherlands, 1860: gives an animated and full account of the whole affair, but of course chiefly on the Dutch and Spanish side, and favourable to the former. He, like Froude, quotes from the original documents in Spain and the Netherlands; and from Herrera, Strada, Meteren, and Bor.

Scott's Archæology of the British Army, 1868: quotes from the records of the Lancashire Lieutenancy.

Dodsley, History of the Spanish Armada, written 1759: gives some details of the land and sea forces in England, in addition to those given in Bruce.

Evening Meeting.

Monday, March 1st, 1875.

VICE-ADMIRAL R. COLLINSON, C.B., F.R.G.S., Vice-President, in the Chair.

NAMES of MEMBERS who joined the Institution between the 23rd February and 1st March inclusive.

ANNUAL.

Robertson, the Rev. Archd., late 51st Regt.
Langhorne, A. R. M., Lieut. 52nd Regt.
Gaussen, Alfred W. G., Lieut. Herts Militia.
Wetherall, W. A., Lieut. Bombay Staff Corps.
Evelyn, C. F., Major 3rd Royal Surrey Militia.
Rowe, Samuel, M.B., C.M.G., Staff Surgeon-Major.
Keays-Young, H. W., Capt. 18th Royal Irish.

ON MILITARY (OR STRATEGIC) AND REFUGE HARBOURS.

By Sir JOHN COODE, Kt., M.I.C.E.

THE subject of "Military," or, as they may perhaps be more properly called, "Strategic" Harbours, which will form the chief topic of this paper, is obviously one which may appropriately occupy the attention of this Institution, but questions may well arise as to the propriety of its treatment by a civilian. It would seem, however, that a professional connection with one of the most important of the Strategic Harbours recently constructed in this country, and service as a member of the last Royal Commission on "Refuge" Harbours, have, in the opinion of your Council, constituted a sufficient qualification for the duty.

Entertaining considerable fears as to their expectations being somewhat disappointed, I have, nevertheless, at the Council's request, undertaken to deal with the subject, feeling, as I do, that whatever may be the faults and shortcomings of the paper itself, there is good reason to hope that the discussion which must follow will serve to ventilate the whole question, and thereby attract that amount of attention which its importance seems to demand.

With this explanation, which has appeared to be alike due to the Members of the Institution and to myself, I shall proceed, merely premising that I confine myself strictly to the subject of *artificial harbours*, not entering upon the defences of our Naval Arsenals, nor of the great Ports situated on large Rivers, such as the Mersey and Clyde; the requirements at these points fall more properly under the

head of local defences,—I should not, therefore, presume to touch upon them before this Institution.

What I shall have to say may be regarded as in a great degree supplemental to the able paper of General Collinson read before your Institution last year, in which the whole subject was treated in the broadest and most comprehensive manner; mine is a humbler attempt to supply information, and call attention to certain facts and considerations which have a very material bearing upon a question, the importance of which does not appear, up to the present time, to have been sufficiently appreciated.

I propose in the First place to give a brief general description of the "National" Harbours which have been constructed in modern times upon our own and neighbouring coasts, and of the defensive works by which they are protected;

Secondly. To offer a few remarks upon the conditions to be fulfilled in order to obtain a satisfactory Strategic or a Refuge Harbour;

Thirdly. To enter upon a consideration of the facts and circumstances which bear upon the question of the need which exists for a further work or works of this class, and of the selection of the most suitable site or sites for the purpose; and,

Finally, to offer such general remarks as seem to arise out of a review of the whole subject, but more especially on the Strategic branch of it.

Plymouth.

Commencing then with the most westerly of our Artificial Harbours, the first in order is Plymouth. The large embayment known as "The Sound" forms the outer anchorage for the two inner divisions of the "Hamoaze" and the "Catwater;" the Naval Establishment of Devonport is situated on the eastern shore of the former, and the commercial harbour of Plymouth proper lies on the northern shore of the latter.

The well-known Plymouth Breakwater was commenced upwards of 60 years since, the first stone having been deposited on August 12, 1812. This work consists of a detached or isolated Breakwater placed across the middle of the Sound, having its main or centre arm 1000 yards long, and an eastern and western arm or kant each 350 yards long, making a total of 1,700 yards, or 5,100 feet. The eastern extremity terminates in a depth of 6 fathoms at low water of spring tides, and the western extremity in a depth of from 7 to 8 fathoms; the general direction of the Breakwater is nearly east and west by compass.

The areas of sheltered anchorage are as follows:—

Depths at Low Water.	Areas.
3 fathoms and upwards	1,380 acres.
4 " " "	1,260 "
5 " " "	800 "

The cost of this Breakwater up to 1858 was £1,517,000.

The entrances to the Harbour at Plymouth are defended by three powerful works recently completed.

The Fort immediately behind the centre of the Breakwater is a circular work of iron, commanding both channels into the Sound, and also the water outside the Breakwater as far as its guns will carry. The western or principal channel is guarded also by Fort Picklecombe, a new casemated work supplied with iron shields and armed with heavy artillery. The eastern channel is guarded by Bovisand Battery, a work of a similar character to Fort Picklecombe. Should an enemy penetrate within the Breakwater in spite of these defences he would have to pass under the fire of Drake's Island Batteries, which are armed with new and powerful guns; of Garden Battery, also armed with modern artillery; and under the fire of some of the older fortifications, and of the batteries in the neighbourhood of the Royal William Victualling Yard.

Portland.

The formation of a large Harbour at Portland appears to have been first agitated in the latter part of the last century. In the year 1843 a Select Committee of the House of Commons on "Shipwrecks" recommended the immediate attention of the Government and Legislature to the subject of the formation of Harbours of Refuge. In April 1844 a Commission was appointed to enquire into the subject so far as regarded the English Channel; of this Commission Admiral Sir T. Byam Martin, G.C.B., was Chairman. The New Harbour Works at Portland were undertaken in accordance with their recommendations. The preliminary works were commenced in August 1847, and the Breakwater was finished in 1871.

The Harbour is formed by an inner Breakwater Pier 1,900 feet in length, connected with the shore near the most salient point on the eastern side of the Island, and an outer or isolated Breakwater 6,200 feet in length—the two being separated by an opening or passage 400 feet in width; the outermost head is distant from the shore 8,500 feet, equal to a mile and five-eighths. The greater part of the work is in rather more than 9 fathoms at low water of ordinary spring tides. The areas of sheltered anchorage within the Breakwater are as follows:—

Depths at Low Water.	Areas.
3 fathoms and upwards	1,590 acres.
4 " " "	1,430 "
5 " " "	1,290 "

The total cost of the Breakwater and Harbour Works was £1,033,000.

The defences of the Harbour of Portland comprise several powerful works. The Verne Citadel at the summit of the island is a Fort of extraordinary strength. The cliffs on the north and east render it inaccessible on these sides. On the south and west all approach has been cut off by the excavation of an enormous ditch 120 feet wide and

80 feet deep for a portion of its length. The guns of this Fort will command the waters of the Harbour and of the West Bay.

Below the Verne on the eastern slopes of the island are some earthwork batteries mounting heavy guns, and furnished with modern appliances.

At the end of the outer Breakwater a powerful iron Fort is being constructed to guard the entrance to the Harbour. A small granite work has been placed on the extremity of the inner Breakwater to defend the Passage. This Passage is also protected by the batteries on the eastern slopes of the island, just adverted to.

Further, to deny the harbour to an enemy, and to support the Breakwater Fort, a strong casemated work has been built on the Nothe Point, above the entrance to Weymouth Harbour; this work is armed with modern heavy ordnance, protected by iron shields.

Alderney.

The island of Alderney is situated 55 miles south of Portland, 88 miles south-east of Plymouth, and 80 miles south-west of Portsmouth; it is distant about 7 miles from the coast of France, the nearest point being Cape La Hague.

Alderney Harbour is situated on the north side of the island; it is formed by a pier or Breakwater, about 1,610 yards in length, extending in a north-easterly direction from Grosnez Point, which is the westernmost headland of Braye Bay. The breakwater is built in two straight lengths, joined by a circular curve, concave to the sea, the radius of this curve being 500 yards, and its length 175 yards; the first straight length (that nearest the shore) is 1,000 yards long, the outer length being 435 yards. The depth of the original sea-bottom along the line of Breakwater increases from the shore to 130 feet below low water of the lowest tides, at the head. The outermost 600 lineal yards of this work have been constructed in water having an average depth of 105 feet below lowest tides; the original depth under the outermost 300 lineal yards of the work averaged 125 feet.

This Breakwater is exposed to the whole force of the Atlantic sea, which strikes it at right angles, the destructive power of the waves being greatly increased by the rapid tides which prevail.

The areas of the sheltered anchorage within the Breakwater are as follows:—

Depth at Low Water.	Areas.
3 fathoms and upwards	150 acres
4 " "	114 "
5 " "	80 "

The cost of the Breakwater up to 1872 was £1,274,000.

The island of Alderney was strongly fortified in connection with the harbour some years ago. The most important work, called Fort Albert, is situated on Mont Touraille. This fort, and also the work at Chateau l'Etoc, were designed to deny the harbour to an enemy. The numerous other forts and batteries in the island are intended to prevent a landing

in any part outside the harbour, in the event of advantage being taken of fine weather to make an attempt to do so.

Dover.

The work which has been in progress at Dover since the year 1847, and generally known as the Admiralty Pier, commences at Cheesman's Head; it runs first in a southerly direction, and then inclines to S.S.E. It is now about 2,000 feet in length, and it is satisfactory to find, by a comparatively recent decision of the Government, that it has been determined to construct such a harbour as will give complete shelter from all winds, instead of stopping the works on the completion of this western (Admiralty) pier, as had been intended. The position is far too important in a strategic point of view to admit of the bay being left unprotected from southerly and easterly gales.

It is understood that the new arm will be commenced at a point on the shore at the eastern extremity of the town, and immediately under Dover Castle. This work will run in a south by west direction, for about 3,800 feet, and then turning across the bay will run in the direction of west by south for about 2,200 feet. Between the extremity of this arm and the outer end of the Western or Admiralty Pier, when completed, there is to be an entrance 500 feet wide.

The areas of sheltered anchorage within the proposed work will be:—

Depth at Low Water			Areas.
3 fathoms and upwards		....	170 acres
4 do.	do.	....	145 ,,
5 do.	do.	....	122 ,,

The cost of the western arm now in progress will, when completed, have been about £800,000; the estimated cost of the proposed eastern work is stated to be £750,000, or together, £1,550,000.

There are sea batteries overlooking the new harbour at Dover; their object is to deny the use of the harbour to an invader, for whom it would otherwise be a most convenient port of debarkation, and also to retain it in our hands as a secure base of operations, and as a coaling station for our vessels, whence they might operate either towards the North Sea, or down the Channel. Some of these sea batteries have been remodelled for the reception of the heavy artillery now used for naval and coast warfare, and at others work is still in hand. Operations are now in progress at the end of the Admiralty Pier (which, when the harbour is finished, will form the western arm of the Breakwater), for the purpose of laying the foundations for the reception of a turret to guard the harbour entrance.

Harwich.

The harbour of Harwich is situated on the shore of the North Sea, about 68 miles E.N.E. of London, and 20 miles from Colchester. The entrance to Harwich is exposed from south-east to south-west. In

accordance with the recommendation of the Refuge Harbour Commissioners of 1844, it was decided to construct a breakwater groyne, running in a straight line about 800 yards in a south-east direction from the base of Beacon Cliff to Cliff Foot Rocks, at an estimated cost of £50,000. The object of these works was to give additional protection to the port, to increase the depths of water at the mouth, and to check the advance of the Shingle Spit, at Landguard Point, which forms the north side of the entrance.

The defences of Harwich Harbour consist of a powerful fort on the spit or tongue of land known as Landguard Common, lying immediately on the north-eastern side of the harbour entrance; there is also a battery on the hill lying immediately to the south of the town of Harwich, and just at the back of the Beacon Cliff. This work and Landguard Fort command the harbour entrance and sea approaches. Within the harbour, and on the high point of land separating the rivers Stour and Orwell, there is a large, newly constructed battery, which commands the anchorage ground and the area between it and the sea.

The work at Landguard is now being re-modelled for the reception of heavy modern artillery, and is being provided with shields for the protection of the guns.

Holyhead.

Holyhead is situated at the western extremity of the county of Anglesea, in North Wales. Being in the main track of the commerce of the Irish Sea, and at the extremity of the promontory which forms the nearest point of central England to the Irish shore, its position is highly favourable for the construction of a "refuge," as well as a "packet" harbour for facilitating communication between England and Ireland. Eminently useful as it is for both of these purposes, the absence of fortifications would seem to indicate that it is not regarded as possessing any special importance in a strategic point of view. The Breakwater commences at Soldier's Point, just under Holyhead Mountain, and runs in an E.N.E. direction for a distance of 2,000 feet; it then turns to E.S.E. by a curve *convex* to the sea, and runs for a further length of 3,000 feet, when it again turns in an E.N.E. direction by a curve, which is *concave* to the sea, and is continued for a further length of 2,800 feet, the total length being 7,800 feet. The outer end is terminated by a massive head and lighthouse.

The areas of sheltered anchorage within the Breakwater are—

Depth at Low Water.	Areas.
3 Fathoms and upwards	300 acres.
4 do. do.	260 ,,
5 do. do.	200 ,,

The cost of the Breakwater and works connected with it has been £1,285,000.

Kingstown.

The harbour of Kingstown is situated on the south side of the Bay of Dublin. It is formed by two arms or piers which were commenced

in the year 1817, they are carried out nearly at right angles to the shore, where the distance between them is about 3,700 feet. These piers run first in a north-easterly direction and parallel to each other for a length of rather more than 2,000 feet, they then gradually converge so as to leave an entrance between their heads of 750 feet. The total length of the eastern arm is 4,200 feet, and of the western arm 4,500 feet.

Kingstown is used chiefly for refuge purposes and for the mail packets; it does not possess any special value as a strategic harbour. The depth of water is not sufficient for ironclad vessels of the largest class.

From the great width of the entrance and its exposure, this harbour is by no means as secure as could be desired during the prevalence of easterly gales.

The areas of the anchorage are—

Depth at Low Water.			Areas.
3 Fathoms and upwards			130 acres.
4	do.	do.	34 ,,
5	do.	do.	nil.

The cost of the works, including packet pier, to 1859, was £814,000.

Cherbourg.

Cherbourg is situated on the west coast of France, in the province of Normandy, and upon the northern coast of the peninsula called Cotentin, and is 58 miles from Portland Bill. It lies midway between Cape La Hague on the west and Cape Barfleur on the east, the distance between them being about 30 miles; strictly speaking, however, Cherbourg Bay may be said to be formed by Cape Querqueville on the west and Isle Pelée on the east; this small rocky island is about three-fourths of a mile long and rather more than half a mile wide, elevated a few feet above high-water mark. The distance between Cape Querqueville and Isle Pelée is about 4½ miles, and the depth of the bay, taken from a chord line drawn between them, is about 2¼ miles.

The bay is open or exposed from east-north-east to west-north-west, the bottom is for the most part sand and fine shells, with tolerable holding ground.

The sudden contraction of the channel between the Bill of Portland and Cape La Hague, about 10 miles to the westward of Cherbourg, causes the tidal currents to run with great velocity, and renders navigation difficult and at times dangerous.

The construction of the Breakwater of Cherbourg was commenced in 1783, and was undertaken for the purpose of obtaining a harbour sufficiently extensive for the anchorage of a French fleet after the destruction of Dunkerque, there being no other refuge on this part of the French coast.

The total length of the Breakwater or Digue is 11,800 feet: it consists of two arms making an angle of 170 degrees with each other, the

salient point projecting seaward; the western arm is 6,900 feet long and the eastern arm 4,900 feet.

The areas of sheltered anchorage are—

Depth at Low Water.			Areas.
3 Fathoms and upwards			1,650 acres.
4 do.	do.		1,350 „
5 do.	do.		890 „

The cost of this Breakwater was £2,675,000 sterling.

The harbour of Cherbourg is protected by numerous fortifications. In the centre of the Breakwater is a large casemated work of masonry called "Fort Central," there is also a circular fort at each end of the Breakwater, three forts along the shore of the bay, a powerful fort on Mont Roule in the rear of the town, and a series of redoubts surrounding the bay and arsenal.*

Wilhelmshafen.

The harbour and naval establishment of Wilhelmshafen are situated on the western shore of the estuary of the River Jahde on the North Sea, immediately to the westward of the mouth of the River Weser. The site of this work was purchased by the King of Prussia from the Grand Duke of Oldenburg in the year 1854. There is now an outer harbour 720 feet long by 340 feet wide covered by two piers; immediately to the westward of this there is an inner harbour 600 feet in length and 400 feet in width, there is then a harbour canal 3,920 feet in length and 216 feet in width, connecting the outer harbour with the naval establishment—a large basin 1,200 feet long and 700 feet wide. Around this basin are arranged the various workshops and stores, with three dry docks having 30 feet of water over the cills, and capable of receiving first-rate ironclads such as the "Minotaur," also slips adapted for constructing and repairing ironclads, with steam factories, &c. These works appear to have been constructed under peculiar difficulties, the excavations have been made in low swampy lands, which had first to be protected from the sea by dykes. Artesian wells had to be sunk to the depth of 900 feet chiefly through sand (with occasional layers of peat, pebbles, &c.), in order to procure water for the supply of the establishment.

The expenditure up to the year 1869 was £1,500,000. During the French war of 1870 the Prussian fleet lay at Wilhelmshafen, the enemy not venturing to approach.

The port is at present defended by an open earth battery on the right bank of the Jahde, just opposite to the harbour entrance, and by a casemated battery on the left bank; the latter is supported by two open earth batteries which cross fire with the guns of the former. The defences *at present* mount about seventy 11-inch muzzle-loading Krupp guns, but it is proposed to secure the harbour and establishment still further by a series of detached forts, which will completely protect it on the landward side; these forts are to be placed along the line of a creek called the Mohde, which can be inundated at pleasure.

* A summary of the foregoing harbours is given in an Appendix

It may be mentioned that Wilhelmshafen is just the same distance from Flamborough Head as Edinburgh is from London.

Before entering upon the question of the necessity for the construction of further "national" harbours, it seems desirable to offer a few remarks upon what must be regarded as the essential requirements of such works, observing at the same time that, although a harbour may leave little or nothing to be desired in the way of meeting all the conditions as respects the strategic part of the question, it may not in anything like an equal degree, be suitable as a port of refuge; if, however, it should be so, by so much the more would its value to the country be enhanced.

A *Strategic* harbour should fulfil the following requirements:—

(*a.*) It should have a considerable area of anchorage ground so far sheltered as to be safe at all times, with depth of water sufficient to accomodate ironclad vessels of the largest class.

(*b.*) It should be so placed as to form a good centre for the defence of some important part of the coast of the country or of the shipping frequenting it, and, if need be, as a base for offensive operations.

(*c.*) It should be situated at a point suitable and convenient for observation of the movements of an enemy.

(*d.*) It should possess facilities for the supply of coals and water to a fleet or squadron; and,

(*e.*) If circumstances permit, it should be connected with the railway system of the country so as to afford ready means for the concentration, embarkation, and disembarkation of troops, and for the supply of military stores and provisions.

To an insular country like our own, ever, of necessity, dependent upon the Navy as its first and chief line of defence, a judiciously placed harbour affording these advantages would greatly increase the power of any fleet or squadron, and, conversely, the effective power of any naval force would be seriously diminished when employed on a coast where no such harbour might exist.

A *Refuge*, in common with a *Strategic* harbour, should possess—

(*a.*) Ample area and depth of sheltered anchorage, safe at all times.

(*b.*) It should be so situated as to give shelter during storms at a part of the coast where such shelter is most needed, and where it may be available to the greatest possible number of vessels trading along it.

Facility of ingress and egress, and good holding ground, are assumed as essentials in either case, and it is to be regarded as a great desideratum that the elevation and configuration of the surrounding shores should be such as to be adapted for the construction, at a moderate cost, of efficient works of defence, which would at least protect the shipping lying within, and to some extent command the approaches.

Having so far cleared the ground as to show what are the essentials

of a "national" harbour, whether regarded from a "strategic" or "refuge" point of view, we come to the two-fold question,—

Is this country at present in need of such a harbour or harbours? and if so, where is the need the greatest?

To the first branch of this question, I answer emphatically "*yes;*" and to the second I venture to reply with equal emphasis, "*on the north-east coast of England.*"

That these may not be characterised as mere dogmatic assertions, I shall now proceed to state the grounds on which they are based.

It needs no more than a very superficial acquaintance with the eastern coasts of the country to recognise the fact that the district comprised between the rivers Humber and Tyne—of course, including both of them—comprehends all the principal commercial and industrial "centres" of the eastern part of England. The magnitude and importance of the trade and commerce of this district are such that they may with truth be said to bear no inconsiderable proportion to the whole of the United Kingdom.

Through the courtesy of a friend resident in the locality, I have obtained the following particulars of the value of the *mining and manufacturing products* of the district known as that of the "north-eastern ports," *i.e.*, of the towns situated on and immediately surrounding the rivers Tyne, Wear, and Tees, including the two Hartlepools, but exclusive of the Humber, for the year 1873. The figures are large, but from collateral evidence of their accuracy, I feel assured that they may be accepted as substantially correct:—

	£
Coals	10,600,000
Metallurgical products, chemical manufactures, glass and clay wares, machinery, &c.	22,900,000
Iron and timber, shipbuilding, and marine engines	5,450,000
	£38,950,000

Thus giving a total which closely approximates to £40,000,000 sterling per annum.

From the Board of Trade "Returns of Navigation and Shipping," it appears that the value of the *exports* alone of the *produce of the United Kingdom* from the ports on the Tyne, Wear, and Tees, including the Hartlepools, amounted in the year 1873 to £14,985,000, or practically to £15,000,000 sterling.

According to the Secretary of the Newcastle and Gateshead Chamber of Commerce, no less than 105 vessels were built on the *Tyne alone* in the year 1873, their net register capacity amounting to 64,933 tons. In their construction upwards of 40,000 tons of iron were used, and employment was given to about 7,000 men and boys, whose wages amounted to about £400,000. It may be remarked that Her Majesty's iron-plated vessels "Defence," "Swiftsure," "Triumph,"

and "Ceberus," and the Indian troop-ship "Jumna," were built on the Tyne.

The men employed in the collieries of the Newcastle and Durham coal fields in 1873 numbered more than 90,000, their wages amounting to £7,500,000 sterling.

These figures will suffice to show the extent of the commerce of the north-eastern ports between the Tyne and the Tees, and the immediately surrounding district.

The trade of the ports on the Humber has of late years assumed large and rapidly increasing proportions, not alone is its extent remarkable, but the value is no less striking; for it appears upon examination of the official returns, that the *Exports of the "Produce of the United Kingdom"* from the ports on *this river alone* amounted during the year 1873 to £37,967,000, or practically £38,000,000 sterling, nearly two-thirds of this (£22,750,000) consisted of cotton and woollen manufactures of various kinds.

These last figures may be commended to the notice of the men of Manchester, of Bradford, and of other centres of our cotton and woollen manufactures, whose goods find their outlet through the Humber, and whose interests in this question are therefore more deeply concerned than they are probably aware of.

Grouping together a few of the more important facts relating to the trade of that portion of the coast comprehended between the Humber and the Tyne (both inclusive), it may be noticed that the vessels which cleared from, and entered at, the ports within these limits in the year 1873 reached the large number of 70,747, amounting to upwards of 16,460,000 tons (including those trading coastwise with cargoes, but exclusive of those in ballast), being equal to nearly *one-fifth* of that of the United Kingdom, *and more than one-fourth* of that of the whole of England.

As regards the vessels which "*cleared*" within the limits named in the year 1873, their tonnage amounted to between 10,000,000 and 11,000,000 tons, or practically the same as that of the *ports of London and Liverpool united*. The value of the "exports of the produce of the United Kingdom" from the ports within the same limits (Humber and Tyne inclusive) amounted in the year 1873 to £53,000,000 sterling, or between one-fifth and one-fourth of the value of the same exports for the whole kingdom.

Having regard to area and number of inhabitants,—extent and value of mineral resources,—variety and importance of industrial interests,—and general commercial activity, the district immediately surrounding these north-eastern ports and rivers may be safely said to be unparalleled; it is certain that upon no part of the coasts of the United Kingdom, and probably nowhere else in the world, will an equal number of vessels, and a corresponding amount of tonnage, be found upon the same length of seaboard.

An inspection of a chart of this part of the north-eastern coast shows at a glance that the most salient point is the promontory known as "Flamborough Head;" this forms the southern limit of the large indent of the coast known as "Filey Bay," which,—although not

exactly so,—is practically midway between the centre of the Coal Ports and the Mouth of the Humber; it is also just midway between the Mouth of the Thames and the entrance to the Firth of Forth. There is a further peculiarity about this particular part of the coast that,—owing to the projection of Flamborough Head, and the ample depth of water close in shore,—all coasting vessels hug the land very close at this point, whilst from the peculiar configuration of the coast, vessels bound to the southward frequently meet with baffling winds which compel them to beat about the Head for a considerable time, and in the event of bad weather coming on, are not uncommonly driven back to, or even beyond, their ports of departure, many being wrecked ere they can reach a port of safety. Moreover, all vessels engaged in the very important trade between the Humber and the Baltic make Flamborough Head their "point of departure" when outward bound, and endeavour to make it their "landfall" when coming home. From these several causes combined, there is at this part of the coast an almost daily concentration of vessels engaged in home and foreign trades, and to an extent such as will not be found to exist in any other part of the Kingdom. Filey Bay is, therefore, admirably placed as a site for a "Strategic" *and* "Refuge" Harbour, not only for the north-eastern seaboard of the Kingdom, but also, and especially, for the great commercial centres to which reference has already been made.

And it is not only in respect of *situation* that this Bay is so well adapted for a National Harbour, but it possesses all the requisites in the way of area, depth of water, good holding ground, facility of ingress and egress, proximity to the northern steam coal field—with which it is connected by railway—stone in the adjoining cliffs, good fresh water, and such elevation and configuration of the surrounding shores as to admit of the ready construction of works of defence.

The capacity of a Harbour at Filey would depend mainly upon the amount of money appropriated for its construction; the form and size of the Bay are such that it would admit of a Harbour of any reasonable extent being formed there. It may be sufficient here to state broadly that for a much less amount than that proposed to be expended at Dover, a Harbour may be formed at Filey with three times as great an area of sheltered anchorage, and with greater depth of water.

After close and careful inquiry, Filey Bay was especially recommended by the Royal Commission on Harbours of Refuge, in 1859, as the most eligible site for a national harbour on this part of the coast.

If it be desired to erect a new convict prison, and it should be decided to employ convict labour upon a harbour at Filey, a very suitable site for the necessary buildings may be found in the immediate vicinity of the quarries that would be opened for the works.

The subject might have been amplified, but enough has doubtless been said to demonstrate the necessity for the immediate construction of at least one "Strategic" and "Refuge" Harbour on the north-east coast of England.

To judge from the far too great indifference with which this subject has been regarded in high quarters for some years past, it may, per-

haps, be too much to anticipate the immediate undertaking of more than one such work, but there can be no doubt that the claims of the Bristol Channel for the construction of a national harbour will rank next in importance, and there can be as little question that there is no site in that channel which combines in an equal degree the essentials for a Strategic and Refuge Harbour as that of the eastern side of Lundy Island; this was also recommended as an eligible site for a national harbour by the Commission of 1859. Situated at the mouth of the Bristol Channel proper, and nearly in the middle of the entrance, it is in advance of the important coal and iron ports and districts of South Wales, and therefore admirably placed for the shelter of any naval force intended for their protection, whilst it would afford a refuge for the mercantile marine on a dangerous coast.

As in the case of the north-east coast, so in that of the Bristol Channel, it is not *alone* the large number of vessels and their tonnage, or the simple *money value* of the trades concerned, which have to be taken into account, but the *character* of the chief items—*coal and iron*,—a material restriction of which in time of war will prejudicially affect the country generally to a far greater extent than that of any other branch of commerce of equal magnitude or value.

It is now proposed to offer a few remarks on the subject generally, it being understood that they are intended to apply mainly to the case of the north-east coast of England, and more especially to that portion of it which lies between the Humber and the Tyne.

In the first place it may be remarked that the reasons which existed for the recommendation by the Royal Commission of 1859 of the construction of a National Harbour of Refuge at Filey, have not diminished in force in the interim, but rather the contrary, seeing that the trade of the district has at least doubled itself within that period; and that the wrecks and casualties on the coasts of the United Kingdom, which numbered 1,051 for the average of 5 years, ending 1857, numbered 1,779 for the average of the 5 years, ending 1872.

It is a well ascertained fact that more wrecks occur annually on the east coast than any other part of the kingdom, and it is also a fact that of these wrecks, two-thirds occur on that part of the coast which lies between the Fern Islands and Flamborough Head.

It is sometimes said that the introduction of steamers (and especially of iron steamers) will give almost perfect immunity from wreck. To this it may be answered, that of the 1,206 casualties on the coasts of the United Kingdom in 1873, 169 occurred to steamships, and of these 169 steamers, no less than 142 were built of iron. Again it has been urged that the conveyance of coals by railway from the north to London is rapidly superseding transport by sea. The best answer to this is to be found in the official return of the Registrar of the London Coal Market, according to which it appears that whilst the quantity of coal brought to London by railway and canal was 462,800 tons *less* in the year 1874 than in the year 1873, the quantity brought by sea in 1874 was 62,000 tons *more*.

It thus appears that, so far as the question of refuge for the Mercan-

tile Navy is concerned, the need for a harbour on the north-east coast is greater now than it was in 1859.

It now becomes necessary to adduce a few leading considerations which bear upon the question of the necessity for establishing a "*Strategic*" Harbour on the coast between the Humber and the Tyne.

A cursory glance at the chart suffices to show the remarkable difference in the number of strategic and well-fortified harbours on the south coast as compared with the eastern seaboard of the Country, along the whole of which, northward of Harwich, there is not a single harbour of this class and not a single fort adapted as a work of defence against modern artillery. It is needless here to dwell upon the reasons which have operated to bring about the construction of so many Strategic Harbours in the English Channel within the last 60 years,—the period which embraces the execution of the breakwater across Plymouth Sound; but the existence of the war-ports on the opposite shore of the North Sea and on the Baltic, and the remarkably rapid development of the German and Russian Navies, are facts which cannot be ignored.

Only within the last few weeks the semi-official *North German News* contained an article from which the following is an extract:—

"In remodelling our naval designs in April, 1873, and laying down "a new plan for the construction of ships, we intended to protect our "commerce, defend our shores, and develop our powers for assuming "the offensive at sea."

Is there not here an example worthy of—if not demanding—thoughtful consideration by the rulers of England as an insular country with such vast and vital interests dependent upon the complete command of the sea?

Our Navy is universally—and obviously must ever be—regarded as our *first* line of defence; but it may be asked what have we at present to rely upon as our *second?* and does not a calm consideration of the facts call for the prompt adoption of all reasonable measures calculated to give the utmost strength and efficiency to our first and all-important arm? Further it may be asked, how can this be done so effectually and economically as by providing a base for naval operations at a critical point? Without such a base, the operations of any naval force must of necessity be materially weakened and restricted.

Much reliance is placed upon the numbers and sizes of our modern ships of war; but granting to the fullest extent which the facts will warrant the present superiority of the British Navy as compared with that of any other country in point of numbers, sizes of ships, and "weight of metal," it must nevertheless be borne in mind that a mere *numerical* comparison by no means constitutes such a ground for satisfaction or security as may at first sight appear. Setting aside for the moment any question of adverse combination, this comparison will fail if we take into consideration the magnitude of our maritime commerce as compared with that of any other country,—the extent to which (from our insular position and large population) we are dependent upon foreign countries for our food supplies,—the great length of coast line to be protected at home—and the number and importance of our

colonies and possessions abroad. Bearing these facts in mind, and giving to them no more than their due weight, we must surely be led to the conclusion that every possible step should be taken for increasing the efficiency of the Navy as the first and most important defence of the country.

The apathy and indifference of the mercantile community can only be accounted for on the supposition that they are so engrossed with commercial pursuits that—in so far as they give to such matters any consideration at all—they place their reliance upon the Government for doing all that is really requisite, whilst there is reason to apprehend that, on the other hand, the Government, in the absence of any representations or pressure from without, have hitherto allowed matters to drift along to a point at which the subject assumes an aspect of such importance as to demand prompt and grave consideration.

What is sometimes and not inaptly designated the "Ostrich" policy, may be very "comfortable," and very economical as *long as it lasts*, but it indicates a state of things from which it is by no means impossible that those who indulge in it may be somewhat suddenly and rudely awakened. There seems to be an opinion among a by no means inconsiderable section of the community that war is a question which rests with England alone. Those who adopt this view must have wholly overlooked the fact that circumstances *may* arise which would put it beyond the power of this Country to avoid this much-to-be lamented climax. It must never be forgotten that it is not beyond the compass of possibility that circumstances may occur in which war might be *forced* upon England.

In an article which appeared in the leading journal of this Country only ten days since, it was said, "Dreams of ideal peace and political "alliance rest on much the same foundations as dreams of conquest "and of war; they are speculations and nothing more * * * "Of all calculations, those that depend on the continued accord of "powerful neighbours are the least to be relied upon" * * *

The same article says:—"To our apprehension the history of Europe "for the last thirty years proclaims one warning more loudly than all, "more loudly than even the fickleness of fortune, and that is the in-"constancy of man." Of the truth and force of these remarks there can, I imagine, be no possible doubt or question.

In these days of such vast armaments and such rapid changes, who, I would ask, will be so bold as to say that war is for us impossible? Let us hope and pray that it may be averted, but we should face the possibility and act accordingly.

These several considerations lead to the inevitable conclusion that our means both for *defence* and for *offence* should be so increased as to meet the circumstances of the times, and that further protection should without loss of time be provided for what are at present the most vulnerable and vital points of the Country, combining with such protection the best means of carrying on offensive operations, if the occasion should unhappily arise.

It is submitted that these objects cannot be attained more effectually and economically with respect to the most important part of our sea-

board than by the construction of a National Harbour on the north-east coast. Such a work would become to the North Sea what Portland is to the English Channel, inasmuch as it would combine, in at least an equal degree, advantages to the mercantile marine in time of peace, and to the Royal Navy in time of war. It would form a permanent and substantial addition to the national defences, and, as such, would constitute a great and additional safeguard for the Country.

Reason must convince us, and experience frequently reminds us, of the wholesome truth which lies embodied in the maxim—

"*Si vis pacem para bellum.*"

Lieutenant-Colonel CROSSMAN, R.E.: I came here to-night not knowing what Sir John Coode was going to say, but intending to advocate what he has advocated so ably, viz., the establishment of a harbour on the north-east coast. He has, however, said so much in favour of it, that it would be impertinent in me to say anything more in its favour. Although Sir John Coode made an excuse for attending here as a civilian, we ought to be much obliged to him for coming to speak of matters that he knows more about than almost anybody else. What he has said is well worthy of the attention of this meeting. I would merely say that as, in a strategic point of view, we have got harbours along the south coast from Plymouth to Sheerness, I think the Government ought to consider a little more before they expend so much money upon a harbour at Dover instead of upon one on the north-east coast of England, where it is so urgently required.

Captain HOSEASON, R.N.: I am sure we must feel indebted to Sir J. Coode for the very able paper that he has read to this Institution, and I believe, following, as it does, the excellent lecture by my friend General Collinson, it never could have been delivered at a more opportune time. I have not come here in any way to controvert a single word that Sir J. Coode has read to the Institution, but simply to draw attention to what the Government are doing in the matter of strategical harbours at the present moment. I shall not enter into any controversy as to whether the formation of a harbour at Dover, which is now on the eve of being carried into execution, is a judicious Act of the Government or not, but I have to deal with it as a fact that the Bill is framed, that the money is about to be voted, and the whole arrangements of the Government are complete for making a strategical harbour there. I shall presently read to you from a paper just laid before Parliament the line of conduct the Government has agreed upon with regard to this measure. This Parliamentary paper, dated February 5th, contains the first intimation given by Government of the Bill which they are about to introduce. The Bill itself proposes to form a harbour at Dover. At present you all know there is only an Admiralty pier. That pier affords a very incomplete protection to vessels entering the roads, because it only yields protection from the westernly winds, and not from the southernly and easternly winds. The plan that the Government has adopted is the one that I sketched out about three years ago. On arriving at Dover from the Continent, I called on my friend General Collinson, and found lying on his table a plan of Sir John Hawkshaw's for making a harbour for the Harbour Board and the Railway Companies. On inspecting the plan, I stated that if it were carried into execution it would ruin one of the finest sites for a strategic harbour in all England. Remember, the strategical value of a harbour may change altogether according to the political circumstances of the country. When the strategical value of Dover was greatest, was during the time when hostilities were frequently carried on with France. The political changes that have taken place may now raise Germany into a very prominent and formidable naval power, and therefore it is morally certain that at some future day the Government will adopt the proposal for a harbour at Filey. The late President of the Board of Trade, Mr. Chichester Fortescue (now Lord Carlingford), said in the House, when opposing a suggestion for forming a harbour at Filey, that if ever Germany rose to any prominence as a naval power, the Government would be prepared to embark in the necessary expenditure to form

a port there, but at the present moment he was not prepared to introduce such a measure for mere commercial purposes. For it must be regarded not merely as a question of a harbour of refuge, but as a strategical port which would render it necessary to fortify it, to erect barrack accommodation, and to make railway communication in connection with it. Therefore, when you speak of the expenditure necessary to form a harbour, you must consider those additions to it which the formation of barracks, docks, and railway communication entails. Now, Dover, on the other hand, has all these advantages already. It has two railways running into the town, placing it in direct communication with our large arsenals at Woolwich, Chatham, Sheerness, Canterbury, and Shorncliffe, and other military depôts. All these advantages are clearly shown in the stragetical map which is published in my pamphlet. At the present moment the Government has a Bill already framed, but as the details are not quite agreed upon, it is not yet before the House. The paper which I hold in my hand, however, now laid on the table of the House of Commons, before alluded to, gives the leading features of the Bill in the following words:—
"With reference to your letter of the 25th February last, and to my reply dated "the 13th May, I am now commanded by the Lords Commissioners of the Admiralty "to acquaint you, for the information of the Board of Trade, that at a meeting held "on the 21st inst., at which the Treasury, War Office, Board of Trade, and Admiralty "were represented, the following points with reference to the extension of Dover "Harbour came under discussion, and were agreed to, namely:

"1. That the works shall be constructed by the Dover Harbour Board.

"2. That the whole of the money required is to be lent by Government.

"3. That two-thirds of the loan is to be repaid.

"4. That the power be given to the Dover Harbour Board to charge dues on "ships.

"5. That the Admiralty Pier be vested in the Dover Harbour Board.

"6. That the constitution of the Dover Harbour Board be altered by the addition "of Government officers thereto."

The object that the Government have in view is not merely to make a strategical port, but to develop and increase the facilities of communication with the Continent. The Government, moreover, are determined that the harbour of Dover shall be made largely to contribute to reimburse the expenditure. The full amount to be asked from Parliament for these works is £970,000. The engineers contemplate the completion of the harbour in eight years, but in less than half that time great part will be available; the expenditure is expected to amount to £120,000 each year, giving as a free grant £40,000 of that sum, and charging £80,000 to the Harbour Board, to be repaid to the country when the revenue of the port will admit. The bulk of the money to be advanced by Government will be as a loan, not as a gift. At the same time it is proposed in the Bill that bye-laws shall be printed, to enable the Harbour Board to levy a passenger tax of either *6d.* or *1s.* a-head. At *6d.* a-head at the present moment such tax will yield about £6,000 a-year, and at *1s.* of course £12,000. Therefore the passenger tax alone will nearly double the revenue of the port of Dover at the present moment, for the whole revenue at present does not exceed £15,000 a year. The area enclosed will be about 350 acres, which will enable the Harbour Board to raise a large revenue from harbour dues, for all shipping entering the heads will have to pay. The distinction between the proposition made by me to the Government and that which was made by the Royal Commission in 1844, is very marked. The Royal Commission proposed that a harbour of refuge or free port should be constructed at Dover. The harbour proposed by me, and which is adopted by the Government, will not be a free port. The difference is transparently clear; the State is merely called upon to loan the money to the Dover Harbour Board, not to make a free gift of it. Being a strategical port, every ship that enters the heads will be forced to contribute to the maintenance of the port; thus a very large revenue will accrue in a few years, I conceive £40,000 or £50,000 a-year will be earned by the Harbour Board towards paying back to the Government both the principal and interest of the sum lent to them. If I understand the proposal correctly in respect to Filey Harbour, it is to be a free port, just like Holyhead, where ships entering contribute nothing. There is another material benefit that will flow from the construction of this harbour. At present no policy

of insurance can be recovered by any vessel lost at Dover, as it is notoriously an unsafe anchorage. Having requested the Lord Chief Justice of England, Sir Alexander Cockburn, to join the Royal Dover Yacht Club, he most emphatically declined to do so, stating that the Court of Queen's Bench had settled the question as to the nature of the anchorage; and he added, that it was a national disgrace that the entrance gate to England should be still left in such a state. You will observe by the map that the Downs is only six miles from Dover, therefore Sir J. Coode is perfectly correct in saying that, having that natural advantage, an additional harbour of refuge at Dover is not so much needed as at Filey. I perfectly agree with him in that respect, and that there is a great demand for a harbour at Filey. But the question is, will the Government by these acts concede the immediate necessity of the one but not the other? It must be remembered that towards this port they have already expended about £750,000 on the Admiralty Pier at Dover, which yields little or no return to the nation in money; when, however, the new harbour is finished, I have no hesitation in saying that in about 50 or 60 years, not only will the million be repaid to the country, but the interest also of the sum that has been expended upon the Admiralty Pier will be fully realised and the Harbour Board be out of debt. It is important to bear in mind that Government pays 1 per cent. less for borrowed money than public companies, and that 1 per cent. will, at compound interest, extinguish any amount of capital in about 54 years. I look to the income of this harbour at Dover, from the proceeds of the passenger traffic and the large increase in the trade of the town, to liquidate not only the loan that is now proposed, but all the principal and interest of the money that has already been sunk. I wish Sir J. Coode perfectly to understand that I am fully convinced that the view he has taken of the value of Filey is correct; but I was pleased to see the vast trade and mining interests involved, for I was not conversant with all their details, but after having carefully perused the able paper by my friend General Collinson, I saw the enormous traffic that was passing through the narrow Straits of Dover, and clearly perceived that a strategical harbour for the defence of that vast trade was an absolute necessity, and therefore I shall continue to urge on the Government the importance of completing as early as possible this important national undertaking.

Admiral Sir HENRY CODRINGTON, K.C.B.: May I ask Sir J. Coode to inform the meeting what he considers will be the approximate cost of a harbour such as he proposes at Filey Bay? Are there the means of constructing a harbour cheaply there? I do not ask for any detail, but giving it roughly, in comparison with Portland, which is a monument of his skill, what would be the expense of a first-class harbour at Filey? I remember a proposal many years ago for a harbour at Redcar, where the rocks afforded some natural advantages, but I have not any information about Filey. I can quite see that a first-class harbour there would be most advantageous to us. Passing now from the subject of large harbours, and referring again to the Channel, where we seem tolerably well protected with large harbours, it strikes me we have too much forgotten the small harbours. An enemy attacking England will, I should imagine, find our large harbours sufficiently well protected, at first, at any rate, and to be too tough a nut for him to crack in his first operations, but if he could discover any place between those large harbours where he could make a lodgment, before we could accumulate forces sufficient to oppose him, he would then have a sort of gate into England, and perhaps we should find some difficulty in dealing with him then. Our forces are mostly massed at the large ports, but what is to become of the small ports, which were so advantageous in previous days in making the commerce of England, and in carrying it up into the interior? I can speak from personal observation of two or three that I have frequented in yachting, and it grieves me to see the way in which they have been allowed to go to the bad and silt up, for want of the commonest energy to keep them clear, and they have been very largely trenched upon by railways bringing down mining produce, to the exclusion of what is necessary for us in war, namely, gunboats. We want a force to be on the spot wherever an enemy may attempt to set his foot, so that he may be prevented from making a lodgment until we can bring down the military from our military centres.

Captain HOSKASON: Perhaps Sir J. Coode is not aware of or his attention has

not been directed to, the new Bill that the Chancellor of the Exchequer has brought into Parliament, which will no doubt greatly further these works. I have reason to believe that that Bill has grown up out of this new harbour at Dover. The fact is the Government has not the funds at their disposal. The Loan Commissioners had only the power to loan £300,000 for all public works all over England; but the new Bill will enable the Government, at their discretion, to bring forward every year any votes which they may judge necessary, whether in connection with the Board of Trade, or any other department of the State; so that if the Bill passes, as I expect it will in a very short time, it will not be necessary for the Government to limit the loans to £300,000, or even £1,000,000.

Vice-Admiral OMMANNEY, C.B., F.R.S.: I think from what I gather from the paper, there is no question of rivalry between Dover and Filey. I think after the very exhaustive reasoning and clear case that Sir J. Coode has presented in favour of a port for the north-east coast, his proposal must receive universal support, and that the influence of the paper that has been read here to-night will extend further than the ears of those who have listened to it. There is no doubt that harbours of refuge are a great source of wealth and strength and commercial prosperity to this country, and I should like to ask Sir J. Coode whether he has ever directed his attention to the formation of a harbour in Mounts Bay. I dare say all seamen when off the Lizard have frequently seen hundreds of merchantmen beating about there, who would have been very glad of a harbour of refuge. The harbour at Falmouth is very circumscribed, and with no great depth of water. I have often, when off the Lizard, thought what an important thing it would be to have a harbour in Mounts Bay. Those acquainted with Mounts Bay will know the ledge of rocks extending from Mousehole Point, which forms a famous foundation for erecting a pier, second only to that celebrated work of Sir J. Coode's at Portland, and I should like to ask him if he has ever directed his attention to that place. I cannot sit down without raising my humble voice in support of his arguments in favour of a port at Filey.

Major-General COLLINSON, R.E.: I am very glad to take this opportunity of expressing my gratification that we have had the benefit of the skill and experience of a well known civil engineer like Sir J. Coode, to assist us in drawing the attention of the public of England to this important question. I hope it will never go forth from this Institution, that there is any question of rivalry between these two places, Dover and Filey. Sir John Coode has shown us very strong commercial reasons in favour of a harbour of refuge on the north-east coast, and he has also shown us some good reasons why it should be a military harbour for the protection of our trade there; and Captain Hoseason has shown us very clearly what would no doubt be an important point with the House of Commons, namely, how they will get a revenue out of the harbour of refuge at Dover; but the fact is, as the commerce of this country increases, so must the public pay for the protection of that commerce. If, for, instance, iron mines should be discovered upon the north coast of Scotland. a great town would arise there, and we should have to make a harbour of refuge there, with places for our war vessels to coal at, and forts to protect our trade there; and if the commercial people of England will not pay the sum necessary for that protection, some day or other they will find that they may not only have to pay a great deal more than they would have to pay now, but may stand a chance of losing the whole trade altogether. I wish to put upon record here two circumstances that have come under my notice lately, to show the importance of increasing our means of assistance to our men of war in time of warfare. They were mentioned to me by a naval Officer, whose name I am sure will always be received in this Institution with great respect—Admiral Sir William Martin. He told me that about the year 1858 or 1859 the superintendents of the dockyards were called upon to report how soon they could make ready for war the ships lying in ordinary and in the first and second class Reserves. I must allow that since that date very great additions have been made to our dockyards at Portsmouth and Chatham, but we must remember that the size and draught of our war ships has also increased. At that time there was a rumour of war flying about, and Sir William Martin, who was then Superintendent of Portsmouth Dockyard, went into very close calculations, and found that, applying the whole force of that dockyard (leaving out all the ordinary repairs and construc-

tion of new ships), it would have taken him two years to get the ships ready. He ascribed that not only to the low condition into which the dockyard establishment had been allowed to get, but also to the want of wharfage and basin accommodation. He expressed himself very strongly indeed about the want of large wharves with accommodation for men-of-war in war time, with considerable depth of water at all times of the tide. That is still a great defect in our great dockyards. He told me that at that time it was considered a very great feat to take four or five men-of-war into Portsmouth Dockyard, get them into dock, and out again, in a couple of tides; but during war we must recollect that time is the essential object in these days of steam, and we should probably have four or five times that number of ships coming to a naval station and requiring at least to lay alongside a wharf. We should also require hundreds of yards of wharfage, with deep water at all times of the tide, at several points along the coast, for the embarkation of stores and troops. We have got really very little of such accommodation now; this shows that even now, with all the alterations that have been made, it is most important to increase the wharfage in still water at different parts of our coast, where the commercial interests require it, and the strategic importance of the place demands it.

Captain HOSEASON: I should like to ask Sir J. Coode if he would favour us with his opinion on the subject of harbours silting up in any way. In modern days does that cause any practical difficulty in the construction of a harbour; that is to say, do steam dredges afford all those facilities which are necessary to keep such harbours clear, however fast the silt may accumulate on the coast of England?

Captain HORTON, R.N.: I beg to venture a remark as to the additional importance of the construction of a harbour at Filey, from the circumstance that, as I believe, between Harwich and the Frith of Forth there is not one estuary or harbour available for our modern ships of war. We have some old training ships in the Tees, Tyne, and Humber; but I believe I am right when I state that there is not one harbour available for a ship of large size, coming in from sea under circumstances of difficulty, or in fact under any circumstances whatever.

Sir J. COODE: What I have to say will be exceedingly brief, and I will endeavour to reply as far as I can in the order in which the speakers have addressed the meeting. As there seems to be an entire concurrence between Major Crossman and myself, I have nothing to say with reference to his remarks. As to the next speaker, Captain Hoseason, at first I thought there was an endeavour to set up a little rivalry between Dover and Filey, but I am happy to find that such is not the case. He spoke of the importance to a harbour of good communication, and I may say as regards Filey, that there is railway communication north, south, and west. Eastward, of course, there cannot be any. As regards the new Bill introduced by the Chancellor of the Exchequer on the subject of loans, I am quite aware of its existence, but it appears to me to be neither more nor less than a measure for the enlargement of the powers of the Loan Commissioners, and I cannot see that it touches this question in any way. If a strategic harbour is required, I do not at all see how you can expect to make it a matter of profit to the country. Why should a harbour, such as I say is wanted on the north-east coast of England, be made a question of revenue more than the harbour at Plymouth or at Portland? They are essentially national questions, and as such I cannot agree with Captain Hoseason, that the new Loan Bill will affect the decision of the Government. The last question was with respect to the difficulty of silting up. Well, if a harbour does silt up, there is only one remedy—that is the remedy which he pointed out—of dredging. If a national harbour, wherein you require something like 5 or 6 fathoms of water, has to be dredged, it is a very formidable business, but it can be done. It is simply a question of money. Certainly, there would be no such risk at Filey. In answer to Admiral Sir Henry Codrington, the cost at Filey, as I said in the paper, is just a question of the size of the harbour you wish to make; but such a harbour as I pointed to—which would necessarily be larger than that recommended by the Commission of 1859, simply because our ships have grown enormously since that time, and therefore to accommodate the same number of vessels a harbour must be very much larger than was required at that time,—such a harbour as I have pointed to would cost in round numbers, without going minutely into the estimate, about £1,000,000, and for that sum you would have a harbour, the deep water area of

which, would be from two to three times that of the proposed harbour at Dover. There is good stone in the cliffs immediately adjoining. The question of the preservation of small ports is a very important one, and, as accessory to a large harbour, I think it is very desirable that something should be done, perhaps more in the direction of giving accommodation for gunboats, in order to protect the coast until a more powerful force can come up; but I fancy Sir Henry would hardly like to see the whole extent of that coast, from Dover to the Frith of Forth as it now is, without some centre or base for naval operations—what I may call a naval centre in contradistinction to the military centres that have been, or are about to be, established by the Government in different parts of the country. I regard a strategic harbour as nothing more nor less than a naval centre to form a base of operations. As Admiral Ommanney very properly remarked, this is not a question of rivalry between Dover and the north-east coast. I am very happy to see the Government have decided upon making a harbour at Dover, which will supply what is evidently a very great need. As regards the question of Mounts Bay, I have looked at that, and a most desirable site it is in many respects; being near the Land's End, it is, in some sense, of value strategically, but I am afraid, until the greater needs are supplied, there is very little hope of getting anything done there. The Government will naturally say, "For that part of the coast Falmouth harbour is available." It is obvious that until you have supplied the greater need the lesser must stand by. There really is not northward of Harwich a single port or harbour along our eastern seaboard where anything like a small squadron of ironclads could anchor and form a centre for naval operations. Looking at the vast trade of that coast, of which I have given the details in this paper—the figures are very large, but I am confident of their accuracy—it does behove the Government speedily to take some steps to apply a remedy. It may be said, perhaps, it is not very wise to call attention so prominently to this very important trade on a vulnerable part of our coast; but I think there is nothing in that objection, for you may be very well assured that these things are as well known in some quarters on the continent of Europe as in England. Perhaps I may mention a little incident which may go far to confirm what I say. When I was on the Continent, just after the close of the Franco-German war, I travelled with a very intelligent Officer attached to the staff of one of the German Generals, and in the course of conversation I found he had a most extraordinary knowledge—not a general knowledge, but a knowledge in detail—of all the principal French fortresses. Of course I could not test the accuracy of his facts, but it was evident that he had at his fingers' ends, so to speak, the fullest information as to all the great French fortresses. I could not help remarking that I was struck with his great knowledge on these points, and I certainly shall not very soon forget the quiet smile with which he said, "I think I ought to know something about them; I had "three years during which my duty was to do nothing else." I thought that a very significant fact, and although some may consider it a little injudicious to speak of the state of our trade on the north-east coast, and the weakness of the country at that point, I do not think so, for I am satisfied these things are as well appreciated, if not better, abroad than they are at home.

The CHAIRMAN: I think Sir J. Coode had not the advantage of being here last Friday week, or he would have heard something about the "Intelligence department" in a lecture which was given to us on that occasion; and I have no doubt that the French and German and Russian Governments are in possession of perhaps better information than many of us who are here at this moment. I would allude in a few words to the necessity of a harbour on the east coast. From my vocation as an elder brother of the Trinity House, I am continually moving up and down the coast, and I may allude to one or two points which have come especially under my notice. In the first place with reference to the coaling stations, Harwich would not take a large ironclad. It is a 16 feet harbour at low water, and there is only 12 feet rise and fall, and consequently with the narrow turn going into it, it is not fit to be used for a heavy draught ironclad. In the olden time Hollesley Bay was much frequented by our ships, and it forms a good roadstead, and is easy of access. Then going up the coast we come to that celebrated roadstead Yarmouth, and I regret to inform you that the changes in the sands opposite that town have been so great during the last two years, that it is not fit for an ironclad to go into from the

southern side. Formerly they could approach it through the Cockle Gateway, and go out through St. Nicholas Gateway; but within the last year St. Nicholas Gateway has shoaled, and when the Fleet went in the other day they were compelled to go out by the Cockle Gateway, and even here there are patches of 23 feet dispersed over it, which, with only 6 feet rise, and fall, would render it hazardous for a heavy ship to attempt to enter. Then I come to the Humber. So far as ironclads are concerned, it is not a safe place. The reach runs straight up from the sea, and I do not think that you could calculate upon being able to go alongside a coal hulk in the Humber with the wind anything between north-east and south-east. The bubble of the sea would be so great, that you could not lay alongside to coal. With respect to the Tyne, no ironclad would attempt to go in there. The narrowness of the entrance and the strength of the tide render it a port not fit for heavy draught or long ships, and from my own personal observation I can tell you that there is nothing between the Thames and the Frith of Forth in which a large ironclad could calculate on coaling with certainty. I therefore cordially agree that the time has come when it is necessary that a harbour should be made on the east coast. In these days of steam we know that vessels must be supplied with fuel. If they are not, their efficiency is gone; yet there is no place where they can get coals with certainty, from Sheerness to the Frith of Forth. There is one observation I would make with respect to the closed harbours. The Downs, and Yarmouth Roads, and Hollesley Bay have been spoken of as places where ships can take refuge from a superior fleet; but if a superior fleet drives an inferior one into such a place, the batteries on shore cannot protect the latter with the same efficiency as if they were in an artificial harbour, where the guns would be outside the ships. I have now, gentlemen, to ask you to join with me in thanking Sir J. Coode for his paper which he has given us. There is no occasion for me to say one word more, for I am sure we must all feel the great debt which we owe to him. The mass of statistical information contained in it, as well as its general character, will render it a most valuable paper for us to refer to in future.

TABLE,

Shewing areas of Sheltered Anchorage, total Cost of Works, and Cost per Acre of Deep-Water-portions of National Harbours (arranged in order of Cost per Acre of Deep-Water-Anchorage).

N.B.—The areas and cost of the several harbours referred to in the body of the Paper are here given at one view, the relative cost per acre being exhibited by the two right hand columns of figures. These figures are adduced for the purpose of showing the comparative natural advantages of the respective sites, and the importance of selecting for any harbour of this class, the most suitable site within any given district.

Name of Harbour.	Areas of Sheltered Anchorage.			Total cost of works.	Cost per Acre taken over deep water portions.		Name of Harbour.
	3 Fathoms and upwards.	4 Fathoms and upwards.	5 Fathoms and upwards.		4 Fathoms and upwards.	5 Fathoms and upwards.	
	Acres.	Acres.	Acres.	£	£	£	
Kingstown	130	34	Nil.	814,000	23,941	no 5 fathoms	Kingstown.
Alderney	150	114	80	1,274,000	11,175	15,925	Alderney.
Dover	170	145	122	*1,550,000	10,690	12,705	Dover.
Holyhead	300	260	200	1,285,000	4,942	6,425	Holyhead.
Cherbourg............	1,650	1,350	890	2,675,000	1,981	3,006	Cherbourg.
Plymouth.............	1,380	1,260	800	1,517,000	1,204	1,897	Plymouth.
Portland.............	1,590	1,430	1,290	1,033,000	722	800	Portland.

* Western Arm (now in progress) £800,000
Eastern Arm (proposed) estimated at........ 750,000

£1.550.000

J. C.

Evening Meeting.

Monday, March 15, 1875.

MAJOR-GENERAL SCHOMBERG, C.B., R.M.A., Deputy Adjutant-General, in the Chair.

NAMES of MEMBERS who joined the Institution between the 2nd and 15th of March, 1875.

LIFE.

Wilson, John G., Lt.-Col. 1st N. York Rifle Vols.
Buxton, J. W. F., Lieut, 27th Regiment.
Biddulph, M. W., Lieutenant 5th Fusiliers.
Dickinson, Edward, Lieut. Royal Engineers.

ANNUAL.

Lascelles, W. R., Capt. Rifle Brigade.
Eden, Morton P., Major R.A.
Taylor, Alexander, C.B., M.-Gen. R.E.
Hickman, D. H., Lt.-Col. Ben. Staff Corps.
Wilson, G. H., Lieut. 26th Regiment.
Tower, Arthur, Lieut. 95th Regiment.
Blomfield, R. M., Captain R.N.
Lawrence, W. A., Capt. Ben. Staff Crps.

ON HARBOUR-DEFENCE.

By MAJOR MONCRIEFF, F.R.S., &c., &c.

SINCE 1866 I have had the honour of reading five papers in this theatre, relating more or less to the question of coast defence—a question, it must be allowed, of some importance in a country like ours, whose frontier is the sea: a country, moreover, which has the largest mercantile marine in the world, and which is becoming every year more dependent on distant colonies and other countries for its resources.

On the last occasion (9th June, 1873), my remarks were mostly confined to the disposition of very heavy artillery, and to answering a paper on my system by an Engineer Officer of the Works Department, who advocated in this theatre the rival system of iron shields and concentration of guns. On the previous occasion on which I lectured here (8th May, 1873), I referred more to that part of the subject bearing on the dispositions of force which would be required to repel invasion, which would only be attempted against this country on a very large scale, with great resources in reserve, and at parts of the coast least provided with the means of defence.

At present the few remarks I shall venture to advance will be confined more to the necessities of commercial and other harbours —the gates through which the commerce of the world passes into our home, and colonial empire, and which are occasionally depôts for our steam Navy. The subject to be discussed in this paper, therefore, is one not only connected with the question of invasion and the strategical conditions involved in that problem, but it has a more immediate connection with the common requirements of an empire depending on the ocean for communication with its colonies, and uninterrupted commerce with friendly countries in all parts of the world.

The defence of the country against invasion is generally treated (perhaps unwisely so) as a contingency too remote to require much attention. The protection of our harbours, however, is a question which at any moment might become of pressing necessity, although no invasion were contemplated at the time. It is, therefore, a question to which it cannot be out of place to draw attention, so long as it is true that inadequate provision is made for harbour defence.

Last year, under the title of[1] "The Strategic Importance of the Military Harbours in the British Channel," Major-General Collinson, R.E., read in this theatre one of the ablest papers I have had the privilege of hearing on this subject. I quite concur, I may vènture to say, as all who have given much attention to the subject do, in the views then advanced by General Collinson. The field, however, is a large one, and there is room for many workers. I trust that my few observations may in some degree supplement what he, Sir John Coode, Captain Colomb, and others have so ably advanced in this theatre on the same subject, as well as what I have myself already contributed to it.

The general naval arrangements for the protection of our extended commerce in every sea—than which a greater naval problem probably does not, and never did exist,—touches this question of harbour defence very nearly, and more so than formerly, because the fleets of England can no longer be independent of them; and steam war ships must have their harbours and coaling stations placed in proper positions in relation to the cruising ground which the Navy has to hold. In maintaining an efficient Navy, therefore, and to obtain the greatest results with a given expenditure, the question must be kept in view how much of that expenditure is to be devoted to the ships themselves, and how much to the harbours, coaling stations, &c., which are absolutely necessary for the ships in time of war.

The feeling of the country generally concedes the paramount necessity for our maintaining a supremacy at sea to protect our commerce, and to counterbalance the military supremacy of other first-class powers. As a rule, however, this concession does not embrace any question beyond the ships. It is not sufficiently known that a modern war navy without proper harbours is somewhat analogous to a modern army without a commissariat and transport. The question is, consequently, a very serious and pressing one, however much it may be overlooked.

Harbours are a most important element in the naval defence of the Empire, and their *proper* and *economical* protection is a question of great and immediate importance. General Collinson says, "A coaling "station should be fortified against an attack by sea, otherwise you "will be providing a depôt for your enemy;" and "It must be re-"membered that every harbour left undefended is not only a loss to "your own vessels but a gain to the enemy."

A share of the resources which are devoted to the defence of the country is demanded both for military and commercial harbours. In what manner this expenditure can best be made is the question before us. To answer this in a short paper is impossible, and one instance is no sufficient illustration, as the conditions surrounding harbours contrast

[1] See Journal, vol. xviii, page 227, *et seq.*

with one another in the most remarkable manner. If I can succeed in indicating the character of the general principles involved, as they appear to myself after some study of the matter, and of the nature of the alternatives at our disposal for harbour defence, it is as much as can be done. It will be expected from me that I shall give the greater prominence to the system which bears my name, and with which I am most familiar. I must take for granted, however, in referring to that system, that its character is understood from my former descriptions, that when the system is spoken of, there is much more implied than merely the gun-carriages which are used to carry it out, and also that it is known that the Moncrieff batteries which have been laid down and constructed at home and in the colonies do not adequately represent that system, but, on the contrary, generally embody many of the defects inherent in works employing iron shields, the other alternative generally adopted for heavy coast artillery.

The protection afforded by sea-going war-ships to the harbours on their own cruising ground, and by the harbours to the ships, is reciprocal. Besides this kind of protection, harbour-defence would consist of four other elements, all of which would likely be more or less represented in each important case.

To obtain the greatest results, however, at the smallest expenditure, each of these elements requires to be increased or reduced according to the character of the harbour, the nature of the approaches to it, and the kind of attack to which it would most likely be subjected.

The four elements referred to are:—

1. Coast vessels of small draught.
2. Obstructions, torpedoes, &c., supported by artillery and coast vessels.
3. Heavy coast artillery.
4. Arrangements for signalling, firing torpedoes, judging distance in the batteries, and enabling all the elements of defence to act in concert with one another.

With reference to the first of these requirements, I believe it is the general impression at present that the most effective vessel for the purpose is a small gunboat carrying a heavy piece of artillery. The positions in which such vessels would be most effective, would generally be where sandbanks and large areas of comparatively shallow water would enable them at considerable range to converge their fire on the larger and deeper sea-going vessels which ventured the attack. Their tactics would be a part of the same plan which included the disposition of obstacles, the laying and firing of torpedoes, and the covering fire of the land batteries employed.

With regard to these vessels, a most valuable suggestion was thrown out in this theatre by the late Chief Constructor of the Navy, Mr. Reed, to the following effect:—

"I would build two or three vessels essentially for training, and I "would provide those parts, such as the forgings of the ship and "engine, which you cannot produce quickly, for the remaining 28 "vessels. Then, if the probability of war approaches, I will venture "to say in a fortnight, or at the most in three or four weeks, you

"might turn out the 30 vessels, and you would have already passed "through the two or three finished boats the number of trained men "requisite to man the whole."

The application of torpedoes has become a science of itself. It appears to me, however, that their application will always be most effective when carried out strictly as a component part of the naval and artillery tactics of each position.

The greatest difficulty in working torpedoes to advantage when the channel is extended, is the establishment of stations from which to work them; and when these stations must be floating ones that difficulty is increased. As a rule, however, harbour defence will be most efficient when the four elements above stated can be brought to act simultaneously and in support of each other.

Putting aside self-acting torpedoes, which are alike dangerous to friend and foe, and which for that reason are avoided, except for special cases, the torpedoes fired by electric means require at least one station for this purpose. It is of some moment that these stations should not only be protected but also concealed, and that any approach to them should be made dangerous to boat parties. Accurate shell guns and howitzers in masked batteries, and in some cases Gatlings, would be the weapons most suitable for such positions and it would in may cases be desirable that the stations should be protected both from land and sea by the same means. In any case it would probably be objectionable to construct such stations so that they could be attacked and destroyed by long range and heavy artillery fire from war vessels, while the necessities imposed by the natural configuration of many harbours would expose them to such attack. In such cases it would obviously be of the greatest importance to utilize to the utmost the power of masking the batteries, which a proper application of the Moncrieff system affords.

For similar reasons the shallows and creeks, if any, on the flanks or in the rear of such stations would often be advantageous for the low and light-draught gunboats above referred to.

It would always of course be desirable to keep the system of defence sufficiently in advance of the docks, and other important property, to prevent their being fired by the enemy's long-range guns.

With regard to the disposition of heavy artillery for purposes of coast defence, and more especially for harbour defence, there is a divergence of opinion, to which I believe it is of the greatest importance that both professional and public opinion should be directed, and I would appeal to both: to the former, more on the ground of efficiency; to the latter, on that of economy.

It is not unknown to the members of this Institution that many millions of money have already been expended on coast fortifications, and that the expenditure on coast works is still proceeding.

The Right Hon. the Secretary of State for War on the 8th instant, stated to the House of Commons that "during 1874–75 £200,000 "will have been expended on fortifications that are being built under "a loan, and I think I may say it has been mainly spent on iron shields "for the forts."

This great expenditure has been almost entirely absorbed by works largely dependent on iron, and on the principle of concentrating the guns, still adhered to, which was advocated by an Officer of the Works Department in this theatre on the 31st March, 1873, and which, in fact, characterises nearly all our works, notwithstanding the serious defect of limiting their lateral range, thereby reducing their value. This principle is very much the old system of coast batteries employed before the introduction of modern artillery, but reinforced by the use of iron shields. In some cases, on the plea of economy or of space, the guns have not only been concentrated laterally, but, as for example, at Garrison Point Fort, and elsewhere, have been mounted in tiers one above another. I submit that it is rarely expedient to concentrate many guns in a small space, and that in the large majority of cases the greater the interval between very heavy guns and the more difficult it is to see their position, the more formidable and embarrassing do they become to the enemy.

The divergence of opinion to which I refer exists between those on the one hand who still advocate this expensive and concentrated system, and those, on the other hand, who, accepting more or less my ideas, advocate the dispersion of the means of defence in preference to its concentration.

I venture to affirm that the great majority of the Officers of both special arms, and of the Royal Navy, approve of the latter alternative. The carrying out of this alternative requires that the works themselves should be simple, as much as possible concealed from sight, capable of being adapted for all future changes in artillery (which casemates are not, without reconstruction), and even allowing of improvised expansion by unskilled labour; while the flank defence could thus be obtained independently of the position of the guns, and increased at need to any extent. For all these purposes the barbette system, especially a protected barbette system, offers singular facilities. In fact, the system consists of the disposition of the guns "in such a manner "as to retain as much as possible for the defence the advantages of a "free lateral range, converging fire, and different amounts of command. In other words, the method consists in placing in position "the heaviest and most powerful artillery to the greatest advantage, "making that the first consideration, and afterwards protecting the "batteries, by separate and distinct arrangements easily devised by "Officers on the spot, against assault by any force that ships might "land for that purpose." The system was considered by the Select Committee appointed to report on it under the following heads:—

"1. That as powerful coast-artillery need no longer be confined for "the sake of protection to ports and embrasures, the new works should "be designed expressly to obtain the full advantage of unlimited "power of traversing, except in special cases.

"2. That as there is now the possibility of concealing from an "enemy the exact position of the guns, they should no longer be "placed as if they were protected by shields and casemates (which by "their nature must be visible); but that on the contrary every peculiarity of the ground should be employed to render the exact position

"of the guns more difficult to determine by a floating enemy: for this "reason, that whatever tends to make batteries difficult to see and to "hit, is as much a protection as that which makes them capable of "resisting a hit when made.

"3. That as a different and more scattered disposition of the guns "is required to obtain the two former advantages, this peculiarity "(which has its disadvantages) should be seized and utilised for other "requirements, and that the arrangements should be considered with "a view to extemporizing more complete protection from assault in "time of war.

"4. That as there will occasionally be detached pits supported by, "or in support of, such works, the pits themselves should, in such "cases, be made defensible by musketry, and the details of these pits "and their carriages should be considered together in relation to this "requirement.

"5. That the arrangements for range-finding, and conjoint action "between batteries in the same work, should be a primary considera- "tion in its design."

I trust you will bear with me if I urge the advisability of considering the system which bears my name, in providing for future harbour defence, so as to obtain for it a share of the attention that is freely bestowed on iron shields and casemates, which, in all but exceptional cases, are the only other alternative giving sufficient protection to the guns and to the men serving them from the attack of heavy naval artillery.

Wishing to confine my remarks as much as possible to commercial harbours, I submit the following reasons why this system is worthy of more attention for that purpose than it has yet received.

In the first place, I would echo the sentiment so eloquently advanced on the 26th February in this theatre by General Collinson in his lecture, entitled "A Warning Voice from the Spanish Armada," viz., that the defence of England was best secured when entrusted to the local action of her own brave people, who should be encouraged to feel that this duty rested on every able man in time of need.

This maxim is particularly applicable to harbour defence.

Commercial harbours are always the seat of considerable populations, and are not unfrequently in populous districts. Their defence should therefore be conceived on a plan which in war time could be expanded, improved, and worked to a large extent by local resources. It is in this way that real efficiency and economy are to be combined.

I would ask whether this desirable result is to be obtained more completely on the system of shield and casemate batteries, the system on which the expensive iron-cased works which have already absorbed five millions of money are constructed, or on the other system, which can be applied at a smaller expense gun for gun, while each gun can be placed so as to do the work of two or more guns behind iron shields, and the flank defence of which can be increased with unskilled labour to any extent that the ground will admit.

The iron-shield-system to be of any avail, involves an immediate

expenditure on complete iron-cased batteries requiring a long time for construction, and which cannot be altered for changed conditions or immediate requirements.

I make the following quotation from an answer by Captain Innes, R.E., in the *Royal Engineer Journal* to Lieutenant English's criticisms on the Moncrieff system:—

"It does not seem probable that works of the type now proposed, "and with well considered details, would have much to fear from the "long range bombardment which the original paper prescribes as the "appropriate mode of attack for shipping to employ against open "batteries; it is indeed only suitable against either a very large or a "very distinct mark, such as a dockyard on the one hand, or a large "number of guns crowded into a small battery on the other. The "open batteries of the original paper are undoubtedly very favour- "able subjects for such treatment, and even the casemated works "would, I think, suffer from it quite as much or more than those "now advocated; they present a very good mark, and their perfect "invulnerability is at least questionable. I do not think there is any "example on record of shipping doing serious injury at a long range, "except to large vulnerable areas or small crowded works.

"Of the two methods, I think the one now proposed may fairly "claim greater elasticity and capacity for expansion; one cannot add "materially to the structure or armament of the casemated works "without a more or less complete reconstruction, during which they "will be in a great measure dismantled and unfit for action; but in the "long roomy batteries it will be possible to interpolate better or heavier "guns without disturbing the old ones till the new are ready, when "some of the lightest may, if necessary, be weeded out, or transferred "to extensions on the flanks; they may also be materially strengthened "by the addition of even comparatively light guns in this last posi- "tion, which will at least distract the enemy's fire from the more im- "portant pieces in a way that could not be done by a similar supple- "ment to the casemated works, which will always stand out clear and "unmistakable from any temporary addition. I was informed, when "at Charlestown during the siege, that only the heaviest guns, which "were but a minority of the armament of the defences, could really "do much harm to the armoured vessels of the attack, but that the "lighter pieces with which they were associated, and which were "easily handled and replaced in case of accident, were found extremely "valuable in drawing off a portion of the hostile fire."

I would here most strongly urge as an objection to the concentration of modern artillery which consumes so much powder, that the volume of smoke emitted would, in some states of the weather, make a large battery more useless than one gun free from this encumbrance.

The fourth and last element, which I instanced as essential in harbour defence, viz., that relating to general arrangements, is one, in my humble opinion, the most important of any; without it the others could not be worked in concert. Powerful artillery is not more effective than light pieces, unless the exact range is known. Each method of defence is by such means reinforced by the other; indeed, the defence

of an important position, without a carefully devised plan of co-operation, is somewhat analogous to an army without a staff. A great waste of power, and the risk of dangerous mistakes in action, would be inevitable without this provision.

It is an element of defence which would be far more troublesome, requiring much more special local study to arrange, but not nearly so expensive as the construction of a showy battery. It would not gratify the eye so much as a majestic fort with ponderous guns all brought together for inspection; but on the other hand, it would be extremely dangerous to the enterprising enemy who ventured within its action, and it would be a means of defence that, in my humble opinion, should be always kept prominently in view in laying down and arranging the defences of a harbour.

The general system now advocated for harbour defence, and composed of the four elements referred to, is one in which the full advantage of converging fire is seized; in which the batteries are connected by screened roads and railways, and covered by trenches for infantry and light artillery; which has a proper arrangement for range-finding and working the torpedoes, and for concentrating the fire simultaneously when obstacles stop the channel; in which the artillery is dispersed and as much as possible masked; which is capable of rapid development on the threat of war; and which is cheap and lastingly efficient.

It appears to me that the great object to be attained in protecting our commercial harbours, is to get, at a reasonable expenditure on *matériel*, the greatest amount of protection along with an organization, and a training of the militia and local volunteers in the use of the weapon with which they will be entrusted on the outbreak of war; this would make a harbour truly formidable to an enemy, and probably deter him from risking an attack.

The majority of those present are probably aware that two important Committees, appointed by the Secretary of State for War expressly to consider the comparative merits of the alternatives now at the disposal of the country for protecting our harbours, and for other purposes, have had this general question before them, and that they both arrived at practically the same conclusion on the subject. That conclusion was extremely favourable to the alternative I am now advocating so far as it was considered by these Committees.

I cannot do better than quote the words of the last official report on the general question.

"In comparing the relative efficiency of guns mounted on Moncrieff "carriages with guns mounted in the ordinary way, the Com- "mittee have to remark that the experience gained with the carriage "for the 9-inch gun of 12 tons, since the date of their report of 9th "December, 1871, fully confirms the opinions they then expressed "as to the superiority of the former in regard to the following "points, viz.:—

"1. Facility of loading.

"2. Facility of laying, and that the gun can be laid with sufficient "accuracy without the exposure of No. 1.

"3. Rapidity, as compared with that of a similar gun on a dwarf or "casemate traversing platform.

"4. The time the gun, when fully engaged, may be regarded "as exposed compared with the time it is fully covered.

"5. The degree of protection afforded to the men, shell-rooms "and expense magazines, as compared with that afforded by iron "shields.

"As regards economy and efficiency, therefore, the Committee "consider the Moncrieff system compares very favourably with that of "the Service, especially when it is considered that from its extensive "lateral range one gun mounted on a Moncrieff carriage may do equal "work with *two or more guns* mounted behind shields.

"The question as to how far it can be adopted at the present time, "when most of the great defensive works of this country have been "completed, or nearly so, can of course only be determined by the "proper authorities. The Committee may, however, remark that in "their opinion the system will be found particularly well adapted "for—

"1. Mounting guns in salients, &c., of land defences, and

"2. Mounting guns for subsidiary defence of existing heavy sea "batteries; they allude more particularly to such works as Pickle- "combe, Bovisand, &c., the guns of which being essentially armour- "piercers, should have associated with them guns of lighter calibre "for shell fire.

"3. *The defence of the great commercial harbours.*

"The expense of mounting a few 12-ton or possibly heavier guns on "Moncrieff carriages would be considerably less than placing them "behind shields or in casemates; while the increased protection "afforded to the men over that of guns *en barbette* would be a matter "of great importance.

"With regard to the employment of the Moncrieff system for "mounting guns of large calibre on sea-defences, the Committee, as "already pointed out, are of opinion that it might be resorted to with "advantage, but the extent of its application necessarily depends "upon local and other considerations, of which the Committee can have "no cognisance.

"Should it, however, be contemplated to project new works for the "defence of important positions, or to supplement existing works by "others of the present type, the Committee are strongly of opinion "that the designs should be re-considered with a view to the employ- "ment of the Moncrieff carriage; and they would suggest that with "the object of securing harmony between the designs, both of works "and carriages, Major Moncrieff should be afforded an opportunity of "expressing his opinion officially upon the plans that may be pro- "posed."

I venture to say that nothing could be more decidedly in favour of the alternative advocated by me than this report, which was made by a Committee which had for years investigated the subject.

I cannot, however, permit myself to doubt that in a matter of such great national importance, as an alternative system for coast defence,

which is both efficient and economical, the Secretary of State for War, who is taking so deep an interest in the great Department over which he presides, will eventually arrive at a decision as to what is the best course to pursue, and the best system to apply in each case.

The Officers who have recently addressed you on this subject, indicated where harbours are required, and when they should be armed. I have endeavoured in this paper—I fear very imperfectly—to suggest how they should be protected if the considerations of economy and efficiency are to have their due influence in the selection of the system which is to be adopted. I have tried to suggest the various points on which a discussion might be raised on the two broad principles of *concentration* and of *dispersion* of coast artillery, with the latter of which my system has always been identified, and I have curtailed my paper to give more time for an expression of opinion on this important subject.

I trust that any gentlemen who advocate the concentration which characterises our present coast batteries, will be kind enough to give me an opportunity of meeting any objections they may entertain to the method of dispersion which characterises my system.

Admiral Sir H. CODRINGTON, K.C.B.: I have listened to Major Moncrieff's paper with great interest indeed, because I feel that, in almost everything—I think I may say, in everything that he has said, I can coincide with him entirely, from what I have seen and experienced. I should think there really cannot be any doubt, at the present day, as to the difference between guns mounted on his plan and those that are mounted on shields, and I have never had any doubt whatever on the subject since I have seen the two systems. The batteries defending Plymouth Sound are first-class batteries, beautifully constructed, armed with the finest guns of the day, defended by the most solid and beautiful shields that could possibly be made, and, I may say, manned by the finest fellows you could see in any country; but it was rather an instructive thing to see that, when those three things were put together—the constructor's work, the engineer's, and the artillery—the system did not work. I was present when the fort at Bovisand was tried, and I thought that it was very instructive. Of course, the object was to fire at a ship supposed to be coming in. The guns had been put in, and were actually mounted, and one was worked and fired, in order to show the efficiency of the battery. When it was run out, it certainly did not project beyond the outer face of the work itself. The consequence was that they had to take the buffers off in order to allow the gun to go out, and, even then, it was just square with, what a sailor would call, the outside face of the port, and no more. You will excuse me, if I use a sailor's term with regard to this matter. Even when fired square in the port, the concussion was very great, and a good deal of smoke and fire came in; but that was nothing compared to what the effect was when, supposing a ship had passed the direct right angle, and they had to fire to the extreme right or left, as the case might be, the gun was fired when trained to the right, for the muzzle of the gun was then within the outer face of the work. I do not think that gun would have worked at all; in short, I am sure it would not. The quantity, not only of smoke, but of fire, that came in then, and the concussion, were so great that nobody could well have stood at that gun. Nobody did stand at it, for everybody retired to a safety-position in the next casemate. We jumped in as soon as we could afterwards, and we found the rope mats or mantelets a hanging mass of fire, although they had been plentifully baptized with salt water. Each time that was the case. The gun thus fired was fired twice, but the experiment was quite sufficient. Everybody was quite convinced that that battery would not do so; and the authorities dispersed. Some time afterwards, I wanted to see what was done, and I went over the battery. They were making some alteration, and, as it was not expedient to alter the racers, they had altered

the inner trucks on the carriage, so as to get it further out. The consequence of that was, that the bolts in the slide, when they came to try and train that gun again, would take the ironwork of the embrasure, and they would have to cut them off; but, even then, the ironwork of the slide itself would have taken the side of the embrasure, so that that gun could not properly be fired with requisite training, even when the alterations had been made. I do not know what they have done with that battery since. I am speaking of three or foury ears ago. It showed, however, that after all the best intellect, in that department had been employed upon the work, there was not the lateral range on each side that is required to deal with a ship coming in. Those batteries were beautiful batteries. There are several there. I merely name the one that I saw these exercises take place in, but the same thing holds good of each of those batteries. So far as they are casemated and point down a channel, where there is not much pointing right or left required, they are excellent in their way for defence. I am speaking however as a sailor, with regard to the general principle, and supposing that I, as an enemy, wished to go into one of those harbours, I would thank any man to be kind enough to put all the defences of the harbour in one place, because I should then know how to dispose my force so as to deal with them. But if they put their guns detached, one or two at the utmost near each other, in different places all round, there is no possibility of facing them. I do not believe that a ship could live against guns detached in different positions all round, but she may have a chance against a battery that she may bring her broadside to bear upon, particularly if she can find an anchorage near one of those beautiful forts, a little beyond the line at which they can train. It is an evil, inherent in guns in such a position, that they cannot train from the excessive thickness of the parapet inside of the shields more than a certain small number of degrees, and, in most cases, a ship will find a place where she will be able to bring her guns to bear upon the fort, and do it a great deal of damage, provided there is nothing else that can hit her at the same time. I am not saying that those forts at Plymouth Sound are not well placed, but I mean to say that detached guns are far more dangerous to vessels than when they are concentrated. There is another thing which I should like to allude to. In the defence of such places as Plymouth and Portsmouth, it is sometimes very difficult to get the quantity of ground that is required for detached guns. The landowner will be content to give up a small corner of his garden, but not a number of places in which an engineer would like to put detached guns. The consequence is, that the Government have to spend a large sum of money to get detached guns placed in position. There are more places to buy from the landowner, and the experience of Government has shown that landowners charge very highly for these things. The same may be said with regard to the connecting roads. If anybody would enquire the price of a road communicating between Polhaun battery, at the back of the Rame Head, and the other fort, Tregantle, they would find that a very large sum was required for remuneration there. It is right to take all this into consideration when we advocate, as I certainly do, detached guns instead of concentrated guns.

Lieutenant Bower, R.N.: I do not presume to criticize Major Moncrieff's lecture, as I am not sufficiently acquainted with the subject to do so, but there is one thing that came under my observation, which illustrates it very fairly. I remember some years ago, at Malta, the "Magicienne" was sent outside the harbour, with instructions to steam in; the forts were ordered to see how many shot they could fire at her while she was coming in. She kept at a speed of eight knots. Previously, Malta had presented to me the appearance of one of the most impregnable fortresses in the world, especially when looked at from the sea, but I was perfectly astonished at the small number of guns that they managed to let off at her. I do not remember the exact figures, but I remember that the "Magicienne," a sixteen gun frigate, managed to fire more rounds than the whole of the forts and batteries of Malta. I would, also, wish to say a few words on the general subject of coast defences. It seems to me, there are two ways of defending our coast, and that we have to consider, not only their advantages, but that which the country is willing to pay for. The two ways I allude to are, first, the defences of the coast itself on our *own* coast, and next, the defence of our coast on our *our enemy's*. I certainly think that the second alternative has many advantages over the first. The first requires large

harbour defences and heavy forts, which, even at the best, cannot be perfectly impregnable. The second requires a large and overwhelming sea force; but the advantages gained by it do not admit of comparison with those gained by the former method. England is a country entirely dependent on her commerce for the sinews of war, and if we maintain a sufficiently large Navy, not only to lock the enemy up in his ports, but to keep him there, we place ourselves in a position to provide the sinews of war and to carry on the war, and at the same time impoverish our enemy. Whilst I am on the subject of harbour defences, there is one point which I should wish to draw attention to. It has already been touched upon by Major Moncrieff. I mean the localization of that defence. During war-time our fleet would have ample duties to perform, and very few men to spare for harbour defence. Foreign nations are now building small torpedo vessels, and we must assume that their advance on our harbours, if made at all, would be made at night. This, on a declaration of war, would necessitate the presence at every one of our large arsenals of a large flotilla of boats during the night. They would have to be kept out, and this watch must last during the whole continuance of the war. The Navy is unable to provide the men for such a case, but there are watermen and fishermen in all our ports who are thoroughly acquainted with the harbours to which they are attached, and it is only necessary properly to organise them in order to keep up the necessary picket and sentry duty off the mouth of the harbour. They would not be required to fight, but their duties would be confined to giving warning of the approach of ships, so that the forts might be ready to receive the enemy. I would strongly urge the necessity of some such organisation at Portsmouth, Plymouth, and all our large ports.

Captain NESBIT, R.A.: I should like to ask Major Moncrieff a question with regard to a statement at the end of his lecture. He mentions that the second Committee in their report recommended very strongly, that the plans of batteries in which his system is adopted, more or less, should be submitted to him, or at least that he should co-operate to a certain extent with the engineers and those charged with the construction of the batteries. I should like to ask him whether, in any of these matters, he has been consulted by the Royal Engineer Department, because it appears to me to be one of the most important points with regard to the adoption of his system, that the inventor, who is aware of its capabilities, should have a voice in directing, or at least pointing out such modifications as would be necessary for the construction of batteries under his system. His theory of a diffusion of artillery instead of concentration, has already been largely adopted in this country. At the nd of the great continental war in 1815, Martello towers were constructed all over the country for the defence of the coast. There was a frigate powerfully armed kept off by one or two guns on the coast of Sicily. Of course, these towers, being constructed of masonry, are not adapted to the exigencies of modern artillery, but they were examples of the diffusion of artillery as opposed to concentrating guns at one point. Of course there is no comparison between the Martello towers and Major Moncrieff's battery, further than the mere fact that both were opposed to the concentration of the defence. Of course the Martello tower is an obsolete matter in fortification now; but the Moncrieff battery, which is more or less invisible at ordinary ranges, adopts the same principle without the inconveniences of the old Martello tower.

Colonel STRANGE, F.R.S.: I think the question that has been put to Major Moncrieff a very pertinent one, and bears on a passage in the paper which, in order that I may be exact, I will read as follows:—"I must take for granted, however, in "referring to that system, that its character is understood from my former descrip- "tions, that when the system is spoken of there is much more implied than merely "the gun carriages which are used to carry it out, and also that it is known that the "Moncrieff batteries which have been laid down and constructed at home and in "the colonies do not adequately represent that system, but, on the contrary, "generally embody many of the defects inherent in works employing iron shields, "which are the other alternative generally adopted for heavy coast artillery." I understand from that, that the system known by the name of the inventor has not been carried out in its integrity in certain cases, and that would certainly imply that Major Moncrieff has not been as fully consulted as the Committee, whose report he

quoted, recommended he should be. I think, therefore, the question that has been asked by the gentleman behind me is a very appropriate one, and I hope Major Moncrieff will throw some light upon that subject.

Captain R. A. E. SCOTT, R.N.: I am sorry that Sir J. Coode's paper[1] only came into my hands this evening. It is impossible to master such a very important paper at such short notice, so as to speak of its more salient points as I should wish; but at the same time there are one or two remarks which occur to me. We have just heard that our large seafaring population is close to where an enemy would try to effect a landing, and thus our shores are provided with the chief means of defence. Sir J. Coode has advocated Filey Bay as the best central position for a harbour of refuge. There can be no doubt of the value of such a harbour for our mercantile marine, and it would also be of the first importance in any naval war to have so good a base of operations in the North Sea. Without such a position as Filey Bay I really do not see where on the east coast a base of operations could be established. We want on that shore a place where our ironclads could assemble, and where our gunboats also could find shelter. I look upon gunboats as a most important arm, but not such small gun-boats as we have at present, mounting only an 18-ton gun. The gunboats we should have upon our coasts ought to mount guns quite as heavy as anything that could be brought against them, so as to be enabled to attack the most powerful ironclad, with a certainty of penetrating her. At the same time these gunboats should have great speed, for without high speed they would be of little use; for gunboats ought in fact to be like a nest of hornets, following up any enemy that may put in an appearance, and acting as our vessels did with regard to the Spanish Armada; that is to say, if not directly attacking an ironclad squadron, or any off stragglers from it, and entirely precluding a landing. But without a harbour on the east coast what are we to do in time of war? Our ironclads and cruisers carry from six to ten, and some of them even fifteen days' coal; and some might perhaps carry sufficient fuel for twenty days' steaming, because it is not always necessary to go fast; but directly an ironclad or cruiser is out of coal she is in reality no longer formidable as a war vessel. As regards sails, most men in command of ironclads would like to get rid of them altogether when they went into action. Shells might set the sails on fire, and they and their masts might come down upon deck, and very materially interfere with fighting the guns. A still greater danger is that their cordage might foul the screws. In fact, for our heavy war vessels sails are rather an incumbrance than an advantage. Our fast unarmoured vessels have sails that can move them, but if you were to add to the sides of those vessels a couple of thousand tons of armour, you would get such a weighty mass that sails could have very little effect upon it. Ordinarily without steam, and in a swell, ironclads lie like logs (except as to excessive rolling); in fact, with the bigger ironclads it is found not to be safe to keep in close order unless the steam is up, or at least the fires so well banked up that steam could be got up very quickly. It is therefore doubly important to provide harbours of refuge on our own coasts, which would be of course coaling stations. Without these I do not see how England is efficiently to carry on a great war, and keep her fleets and cruisers supplied with coals and other munitions. I might go further and say, that wherever we have vessels in any part of the world we should have coaling stations, so that our cruisers may be kept at all times ready for action, and equal in efficiency to any vessels they may chance to meet. We have to maintain our power in all seas, and we cannot do that without coaling stations. If such stations are so necessary at a distance, how much more necessary are they to furnish a secure base for operations from our own coast, and I therefore think we ought all to feel very much obliged to Sir J. Coode for bringing forward this important subject so ably in his paper. With regard to what Major Moncrieff has said about concentration I think there can be no doubt but that concentration of heavy ordnance is a mistake. It is even a mistake on board ship. The present slow-burning powders give off much more smoke than those used formerly, and this smoke hangs about the ports; heavy firing, also,

[1] The discussion was intended to be taken on General Collinson's lecture, and on Sir John Coode's and Major Moncrieff's papers.

has a tendency to cause a calm, and hence, in the case of concentrated guns, we should not be able to see the enemy after a time. Looking at this question from every point, I think there can be no doubt but that the dispersion of heavy guns is a much more valuable arrangement than concentration. Concentration was good when we had light guns, but the whole circumstances of war are changed. Now, we have several shot rolled into one. What we fairly want is more powerful guns, more powerful shells; and then we may easily expect that success, which we have heretofore had, and which I believe will ever attach to our fleet.

Admiral OMMANNEY, C.B., F.R.S.: One of the speakers very justly observed that there appears to be room for all the different systems which have been proposed, and there is one thing which I think ought not to be lost sight of, namely, the turret of Captain Coles. I think in coast defences that might be very useful, especially at salient points, such as the extremities of piers and breakwaters. For instance, at some of the salient parts of Gibraltar, I think the turret might be still available, and in narrow channels, such as the Needles passage, turrets on Captain Coles's principle might be applied with advantage, instead of stone fortifications.

Captain OWEN, R.A.: I am sure we must all agree that whether we regard Major Moncrieff's system as the best or not, we owe him our thanks, as soldiers and sailors, for so ably bringing forward the subject of coast defences. At the same time it is almost a pity that such a question should be suffered to degenerate into a mere comparison between one system of protecting guns and another. Surely there is room for both systems. Why then should they be regarded as alternative systems? Cannot they both be used simultaneously? I think they can, and with great advantage. Major Moncrieff has laid before us very clearly the several elements that we require for defending a harbour We all, I am sure, agree with him regarding the four elements which are necessary, and also that the fourth is, as he said, the most important of all. Now, what is that? It is the being able to work all your defences in unison. Why should it not be so then with concentrated fire and with scattered fire, with the Moncrieff system, and with the iron-cased forts. We want them both—we want them all—only let them work in unison. There was another point which Major Moncrieff very fairly alluded to, and that was the utilization of our auxiliary forces. That seems to me to be a subject which ought to have much more attention paid to it than it has. To-night we have heard coast defences discussed principally from a naval point of view, but, as an artilleryman, it seems to me that one of the most important things for us to attend to with regard to these defences, and especially the defence of our great harbours is, the proper training and organization of our auxiliary artillery. We want more auxiliary artillery. We want the auxiliary forces of our maritime towns to be artillery, whereas now, unfortunately, we find them in too many cases riflemen. We want riflemen for auxiliary forces certainly, but we also want auxiliary artillery gunners. We have not trained garrison artillerymen sufficient to man one-half of the guns of our defences, and I say, therefore, that the organization of our artillery forces in those places is of very great importance to the country. I do not think Major Moncrieff's system can be held out as the best of all. It is undoubtedly good, but there are in it some weak points that I think ought to be looked to, though time will not allow of my now discussing them. We want, as he says, control. In a great harbour like Plymouth, for instance, you have several forts scattered about. You have your torpedoes and your coast defence vessels, but these ought to be worked together as part of one great system under one head. If you have your guns scattered along in great rows on both sides of a harbour you will find it extremely difficult so to work them—very much more difficult than in the powerful casemated forts which fortunately for us defend both sides of that harbour, and of which we had such a doleful account just now. After that trial, which was alluded to, I myself had the pleasure of seeing those guns fired without any terrible effects on the gunners. Three guns in both tiers were fired at the same time, and the gunners, I am glad to say, for the sake of my own profession, did not run away from their guns; they not only remained in the fort, but stood to their guns in each casemate without inconvenience.

Admiral CODRINGTON: I am speaking of Bovisand. That was Picklecombe.

Captain OWEN: It is a fort, opposite Bovisand, with guns mounted in exactly a similar manner.

Captain HORTON, R.N.: I have been much struck with the facility there seemed to be on the north side of the Isle of Wight for establishing Moncrieff batteries. It is sometime since I was there, and there may now probably be Moncrieff batteries there. Perhaps Major Moncrieff will say if there are. Opposite to the part of the island of which I speak, was Hurst Castle, and I merely offer this as a good illustration of the necessity for a combination of the different methods of defence at one place. Hurst Castle, I believe, is very much in the condition of the forts described by Admiral Codrington, and would suffer under the disadvantages alluded to by Captain Scott with regard to smoke. The guns there, as I have heard them described, perhaps inaccurately, are pretty much in the condition of those which have been for hundreds of years on the shores of the Dardanelles, that is, they can fire one round at the ships passing. A ship, it is true, would receive a very heavy salvo from the whole of Hurst Castle, with its eighty or ninety guns, providing the smoke allowed the whole of the guns to be discharged at the same ship. A succession of ships passing would undoubtedly suffer very heavily from the discharge of the guns, but it is evident that the advantage would be very great of having guns scattered about on the north shore of the Isle of Wight. I think that is very obvious, and affords a good illustration of the position assumed by Major Moncrieff.

Captain SELWYN, R.N.: It is under great difficulties that any one rises in a theatre of this kind to discuss such a question as this. While, on the one hand, sailors would like to tell their brethren on shore exactly what would be most formidable to them, and how to place the greatest obstacles in the way of an enemy attacking this island; on the other hand, whatever information is given here is very rapidly utilised abroad, and we find our weapons turned against ourselves. We always must have that difficulty in the present state of diffusion of knowledge throughout all countries, but I do think that after all, that profession which will have to conduct the attack on such coast defences as may exist on the breaking out of war, have a right to a very strong opinion, and have a right to have that opinion very deeply and carefully considered. It is not true that shallow waters or narrow waters enable turret ships to act with effect unless such waters have also low shores. Wherever guns with great command are placed, no turret—or armoured ship dares go near them, for she will have shot and shell sent through her decks, and out of the bottom below water, by even light rifled guns. The value of batteries *à fleur d'eau*, even when they possess several tiers of guns, is very much reduced by the use of armour on ships, but the gun of high command is even more formidable than before at close quarters, while at long range behind earthworks it offers scarcely any mark for effective fire. Admiral Codrington has referred to the condition in which he saw a battery in which it was naturally supposed that the guns were in an efficient state, but certainly at that time the battery was not efficient. However, the defects then seen may have led to their correction in more recently constructed batteries, though I am by no means satisfied that all the defects have been corrected. I would ask whether the armour of many of the forts, already completed throughout the island, would offer five minutes' protection from the guns which are now likely to be brought against them. If a shot struck the iron plates outside the gun, would it ever be able to fire a second shot at all? There is not a single battery which would not be pierced by the modern guns; there are more which would not be seriously shaken even by the guns existing at the time they were built. I think I recollect a very strong instance of that at Gibraltar, where the attempt to fire at an extreme training led to the shifting of the whole shield after the construction of the fort, which was supposed to be casemated and armoured efficiently. No one can see the end of the progress which may be made in artillery as an 80-ton gun is now spoken of as being constructed, and Mr. Bessemer, in this theatre, spoke of throwing a 30-ton shot with the utmost confidence. I think we might as well consider whether it is not better to draw upon the whole earth for an armour on land, and upon the whole water for an armour at sea, in which case we should get as much protection as the earth or sea could afford for ever after. As regards the question of the concentration or dispersion of the guns, I am quite sure that what Admiral Codrington has said finds an echo in the mind of every seaman who has ever seen an attack by

seamen upon land batteries. Great casemated land batteries can be singled out and fired at with effect at a distance at which, while under steam, no damage can be done to the ships by the forts. That is not the case with dispersed guns, which will remain as perfectly concealed up to the moment at which they choose to open their fire, as if they did not exist at all, more especially if they are in Moncrieff pits. That is a strong reason for adopting Major Moncrieff's system. As I understand his paper, he claims no more than a fair share of attention. That meets the question of unanimity in defence, referred to by Captain Owen, which is so strongly felt, and which I hope will never cease to be felt in the two services. Major Moncrieff merely complains that his system has been taken from him, and to a certain extent applied not as he would recommend. Is this fair to the public? Are they to be told that we wish to continue an expenditure of which we see no end? We tell you distinctly that we see no end to it, for if you make bigger guns we shall not only have to make bigger ships and docks, and harbours, but to enlarge our casemates, to take those guns. I do not think there is a single casemate now built that would take the heaviest gun proposed. [A Member, "Yes."] It must have been constructed very lately then, or the height between the roofs of the casemates would not admit of elevation or depression sufficient. Have you decided at what point you are going to stop with these guns? and what is to be the shape of the casemates to receive them? This difficulty would not arise in a protected barbette battery.

It is quite true that it is difficult to purchase land at all times when the Government is in the market for it. Generally speaking, John Bull thinks, and perhaps correctly, that when the State has to pay it does not much matter what he asks; but there has been, in the case of railways, a very stringent and efficient remedy applied. I really do not see when the question of national defence arises why the same remedy should not be applied in obtaining the land necessary for fortifications or other means of defence. The most important part of the whole subject is that pre-organised junction in the defence which Major Moncrieff advocates of the trained local militia or volunteers at the great commercial seaports. I am not now speaking of the Naval Seaports, which may possibly be defended by those classes which will increasingly be found under the present system of a moderate length of service around our seaports, perfectly ready and delighted to be allowed to engage in a renewal of their old trade as gunners whenever war arises, but the great Commercial Seaports may not be able to find such men. It is no training at all to put a man on board a ship where he finds a gun which was used some years ago, and may never be used again, and certainly not in war; but if you give those men gunboats, of light draught and high speed, carrying the heaviest guns that can be made, at each port they will make it their pride to make those gunboats as efficient as possible, and will constitute the true nest of hornets of which Captain Scott has spoken. They will not only be ready to meet an enemy, but also to follow him up, so that no landing that will take a considerable time, could be attempted on our shores with any prospect of success. Reserve men may be difficult to find at the right time, and even then they would be without such training as they ought to have. But the local people, the fishermen, and if you like, the militia men and volunteers, could be trained to such service; all this might be done if you were prepared to pay as much, while they were on the service of the country, as would keep their families in the same position as they had ordinarily occupied. Everything in this world is worth in results exactly what it costs, that is, it gives you in material effect exactly what you have paid for it, and those that deceive themselves into thinking that we can get these things very cheaply, or for nothing, will find when war breaks out, that the staff on which they leant has done nothing but pierce their hand. The time may well come when a very fearful retribution will fall upon those who have advocated trying everything that is not likely to answer before the things are tried that have answered well before, or that are likely to answer again, because the latter seem to be too expensive, and the former are offered as cheap bargains.

It is no novelty to find out, when too late, that such bargains are by far the dearest way of doing nothing at all.

Major MONCRIEFF, F.R.S.: With regard to the subject referred to by Admiral

Codrington, namely, the possibility of attacking large batteries while the ships themselves are out of range of the guns by reason of their position, I believe the Engineers are generally very careful to cover most of the ground with some guns, but no doubt when a position is only protected by large batteries with iron shields there are occasionally so few guns bearing on certain points that very awkward consequences might result if the ships discovered these points, and from them operated on the flanks or rear of the works. Take an example that is very near us, the Garrison Point Fort at Sheerness. It is of a horseshoe shape. In this case there is some excuse for placing a number of guns in a small space, although I do not think it was necessary to put them in tiers one above another. I was asked by the Secretary of War in June, 1869, to make a design for a three-gun battery outside Sheerness, which would bear both on the mouth of the Medway, and on the whole channel used by vessels entering from the Nore. If the Deputy Director of Works had done me the honour to carry out that design, which was submitted in October, 1869, before Garrison Point Fort was built, and if a series of such batteries for one, two, or three guns had been distributed along the sea wall between Cheney Rock and Garrison Point, the guns mounted in the upper tiers of Garrison Point Fort would, in my humble opinion, have been thus disposed in a much more effective and cheaper manner than where they are. That fort, although it bears very strongly upon the mouth of the Medway, might be severely handled by reverse fire from vessels in the Thames further down the channel. Its gorge might be breached from this point by heavy guns, and every casemate in it thereby exposed to splinters from the rear without being able to return a shot. I do not know how many guns are mounted in Garrison Point Fort, but a great many heavy pieces are concentrated there. These guns command the mouth of the Medway, but the open sea way is here (indicating the point), and thus, cannot range so far; vessels with powerful long range guns out here (pointing) might operate upon the gorge of this work in a very awkward manner for the fort, while it would be quite unable to answer them.

Colonel Crossman, R.E.: Allow me to say that works for heavy guns are being built now to range along the coast where you allude to, and the work is nearly finished.

Major Moncrieff: I happened to be at Sheerness not very long ago, viz., in July last, and I am speaking of what existed then. No doubt what I am pointing out has been already discovered.

Colonel Crossman, R.E.: And remedied.

Major Moncrieff: It struck me if some of those guns, instead of being put in tiers and all together, had been originally dispersed along this front in Moncrieff batteries they not only would have been less expensive, but much more formidable to a ship attempting to pass than as they now are, cramped up together in one place, where, in certain states of the wind and weather, they will be smothered by their own smoke. The price of ground, no doubt, is sometimes a very serious difficulty, but it certainly had no application in this case. I do not think it is necessary to take this difficulty much into consideration at present. Our object here is more to discuss what is the best method of defence, and others would decide how it should influence the designs in each case. I may remark, however, in regard to the system which has been advocated by me, that if efficiency is taken into account, the saving on each gun would amount to a very large sum, and that it is not necessary the works should be completed. The great thing is, to secure the possibility of rapidly making certain arrangements when they are wanted, which, in any case, would be required in time of war, and, of course, when an enemy is at the door, people will not so much object to have their hedges pulled down. The next point that I took a note of was the remark, with which I very much concurred, that our great defence is our Navy; but, in the preface to my paper, I was careful to point out that for the efficiency of the Navy, it is necessary that a certain number of harbours should be formed and protected; if I have not made a very great miscalculation, I believe that a certain sum spent in this way, in protecting harbours at points of strategical importance, would give greater efficiency to the Navy than the same sum spent on the vessels themselves. The great object is to have a powerful fleet, and a certain portion of the expenditure for obtaining that result, ought to be devoted to the harbours, coaling stations, &c. What proportion of the whole expenditure

should be thus employed I do not pretend to decide. With regard to the question which Captain Nesbit and Colonel Strange asked, it is rather a delicate matter, and one that I would have preferred not to answer. I must, however, confess that neither the recommendations on the point referred to, made by Lord Northbrook's Committee, which formed the agreement on which I took service with the Government (without which I should have been unwilling to have taken that service), nor those of the Committee, quoted in my paper, have as yet been carried out. I think Captain Owen spoke of the difficulty of working scattered batteries, as if it were greater than that of working concentrated batteries with a large number of guns. I was quite surprised at that observation, because it stands to reason that the difficulties in working a large battery are much greater than in working detached guns. In a detached battery you have the same means of range-finding, the same signals and telegraphs; you are as much within reach of the officer who is commanding the whole attack as if you were in a large battery, but without its confusion. An officer could more deliberately perform his duties, without the din, disturbance, smoke, and possibly splinters, that would more frequently accompany action in a concentrated battery. Therefore, I cannot understand how any one can suppose that the difficulty of working in a small battery should be greater than in a large one, or that the power of keeping the whole attack in hand, when it is spread over a number of small batteries, would be less complete than when it is confined to large ones, with the same telegraphic arrangements applied to both. I should like an explanation of this opinion, for I cannot understand what may be alluded to. Firing even a single shot from a modern heavy gun in a fort will create as much smoke as would a whole volley from a battery of ten guns in former times, because modern guns fire ten times more powder. The difficulty of dealing with large volumes of smoke is very serious in action; and no doubt a knowing enemy would take very good care that the wind was in a favourable direction for him, or that the state of the weather was such as would favour him and not the batteries he attacked. On a fine day, a good flank wind would blow the smoke away directly, but an enemy would take good care that you did not get that condition. It must be remembered that he, not the battery, has the power of selection. I think, therefore, when putting down valuable and important pieces of artillery, it is very desirable to have them placed in such a manner as to mask them from the enemy, and obtain the best possible offensive results. With regard to Captain Selwyn's remarks about the complaints which I had made, I beg to say that I repudiate the idea that I made any complaints whatever in my paper—complaints in such a paper would have been out of place. I merely wished to advance general remarks, and to lay down ground for discussion upon the general question whether the Moncrieff system was well suited for application, combined with other systems, in future works. I beg to say I do not at all wish to go back, but to allude to future works; and I desire to raise the large general question, whether it is better to employ a system which is characterised by dispersion of the guns for harbour defence, in preference to blindly adhering to the existing system of massing them in large iron plated batteries. I think there is room for both systems, but I regret that one of them has its hand so deep in the national purse. It is the cuckoo in the sparrow's nest. I only hope that one of the chicks thrown out will somehow get fledged. I trust that the defences of the country may attract more general attention, and that my system may yet be more skilfully applied. In concluding allow me to say that I have considered the subject very carefully, and that I believe no more important question could occupy the minds of engineers, artillerymen, and others, who have the welfare of the country at heart.[1]

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[1] I regret that I forgot to answer Captain Horton's question. In reply to it, I now beg to say that in 1871 I was requested by the Secretary of State for War to give designs for the position referred to by Captain Horton, viz., Cliff End, for twenty guns. The following is briefly what was submitted.

My plans showed a ditch which could not be enfiladed by an enemy, enclosing a space well adapted for a small encampment, with a good well; there is a defensible barrack immediately in rear of the position. One caponier enfiladed the whole of

Captain Owen: I have no wish to enter into a long explanation, but every artilleryman knows there are occasions when it is much better for guns to act *en masse* than separately. It has been felt over and over again.

Sir J. Coode, being called upon by the Chairman, said: I do not know that I have any particular remark to make. The views which were expressed in my paper read in this theatre a fortnight since met with such general approval on that occasion, and have not been objected to this evening, so that I do not know that I have anything further to say. As far as I recollect, not a single objection has been offered to it. So far, of course, it is satisfactory to me. Certain questions were asked on the last occasion, and those I answered to the best of my ability, and, therefore, I do not think I need detain the meeting, more especially at this late hour. I might, however, make one remark in reference to what fell from Captain Selwyn just now. He spoke of the difficulties that exist with regard to the purchase of land, and thought the same system which prevails with regard to obtaining land for railways might be adopted in the case of our land defences. Now, I think there is such an Act, called the General Defences Act, which is operative at any moment in case of difficulty. I entirely fall in with what has been said by Major Moncrieff, with regard to the importance of harbours as a means of increasing the strength of our Navy. There can, I imagine, be no question that strategical harbours will permanently increase the strength of our Navy. It should be borne in mind you can make a harbour like that at Portland, for the price of a *little more* than that of *two* ironclads; such a harbour at Filey would not only permanently increase the efficiency of any naval force that might be employed on a part of the coast where in time of war it would be most wanted, and also afford refuge in storms to the mercantile marine for all time. I think that is a point that should not be lost sight of.

The Chairman: I am sure you will all join with me in thanking Major Moncrieff for the interesting lecture he has given. I dare say he feels as I do, that it is a great pity there has not been a little more wholesome opposition to the views he has brought forward. I should like to make a few brief remarks on the discussion. Something was said about the slow fire of a battery—the slow steady fire of a battery may be very formidable. You know I am a Marine Artilleryman, and as such I would speak of the disadvantages broadside ironclad ships have to encounter from the smallness of their ports, which often must cause their fire to be slow. And if you read the account of the American War, you will find a good deal said about the *blindness* of the *monitors*. We are remedying this in our Navy to some extent by constructing ships to carry guns mounted *en barbette*.

Something was said about localisation for coast defence. I have long been of opinion that if you told the fishermen even of Clovelly, where the Royal Navy is not very popular, that they would never be moved from their homes, and that if they chose to go to drill, when war came, they would only be required to defend their own harbours, you would get plenty of volunteers; but you fail to attract them if you throw out any hints of distant foreign service. With regard to the question of Martello towers, and "diffusion of artillery," I think it would be a great pity if

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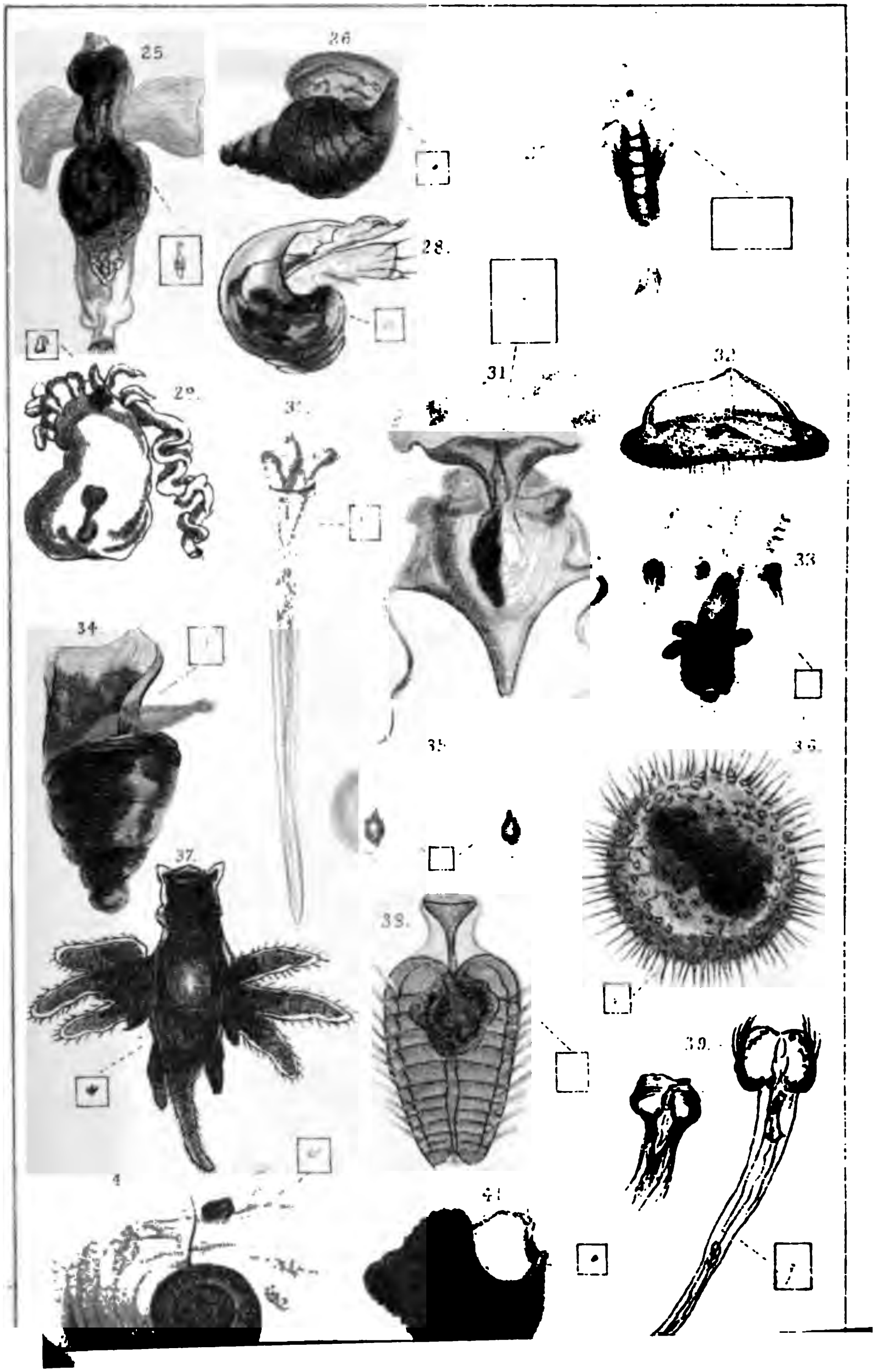
the ditch. The ground falls away to the rear of the position in a gentle slope, forming a slight valley, with another slope further back, all of which was commanded by lines of musketry, and by the guns, which were well dispersed.

The important face of the battery on the West Cliff crossed fire with Hurst Castle to the west; and the guns on this face were all mounted on Moncrieff carriages, with a command varying from 60 feet to about 105 feet. The gun with the greatest command, with 5° depression, bore on the Channel at 360 yards from the nearest point of the sea wall; the same gun was about 900 yards from the end of How reef. The guns on the summit of East Cliff bore north, and were mounted *en barbette*, with a command of 125 feet.

In reference to the fourth *element of defence*, referred to in my paper, I also strongly urged for this position the application of my system of range-finding, &c., which, as stated, I consider the most important part of the Moncrieff system.—A.M.

wrong ideas were allowed to prevail on that subject. I perfectly agree with Major Moncrieff as to the advantage of having guns diffused over a large space of ground. I would not say, abolish Picklecombe or Bovisand, but I quite agree that guns in detached posts here and there would be of great use, and very difficult for ships to silence. But those guns must be within *hard hitting* distance of the object, and they must be under the perfect command of one mind. The whole system of defence must be organised; and when once we have made up our minds how to defend one of the ports, say Portsmouth or Plymouth, or a mercantile port, we ought to go to drill and see how it can be done, and how batteries, torpedoes, and gunboats can be made to work in concert. We ought to have a plan and system, so that when war comes, we may not have to improvise a system of defence. Something was said about gunboats. I am not a sailor, but I think there is a very important point about gunboats. You must have gunboats large enough to face a heavy sea. I doubt if many of our present gunboats could, for instance, keep a rendezvous at Beachy Head in very bad weather. With regard to Sir J. Coode's able lecture, I have only one remark to make. As was said by Captain Scott, in the question of harbours, we must not think of England alone. It is an *imperial*, not an *insular* question. Our fleet is perfectly useless without coal, and unless we have some posts for coaling at certain strategical points all over the world, and these tolerably well defended, our ships will not keep the sea.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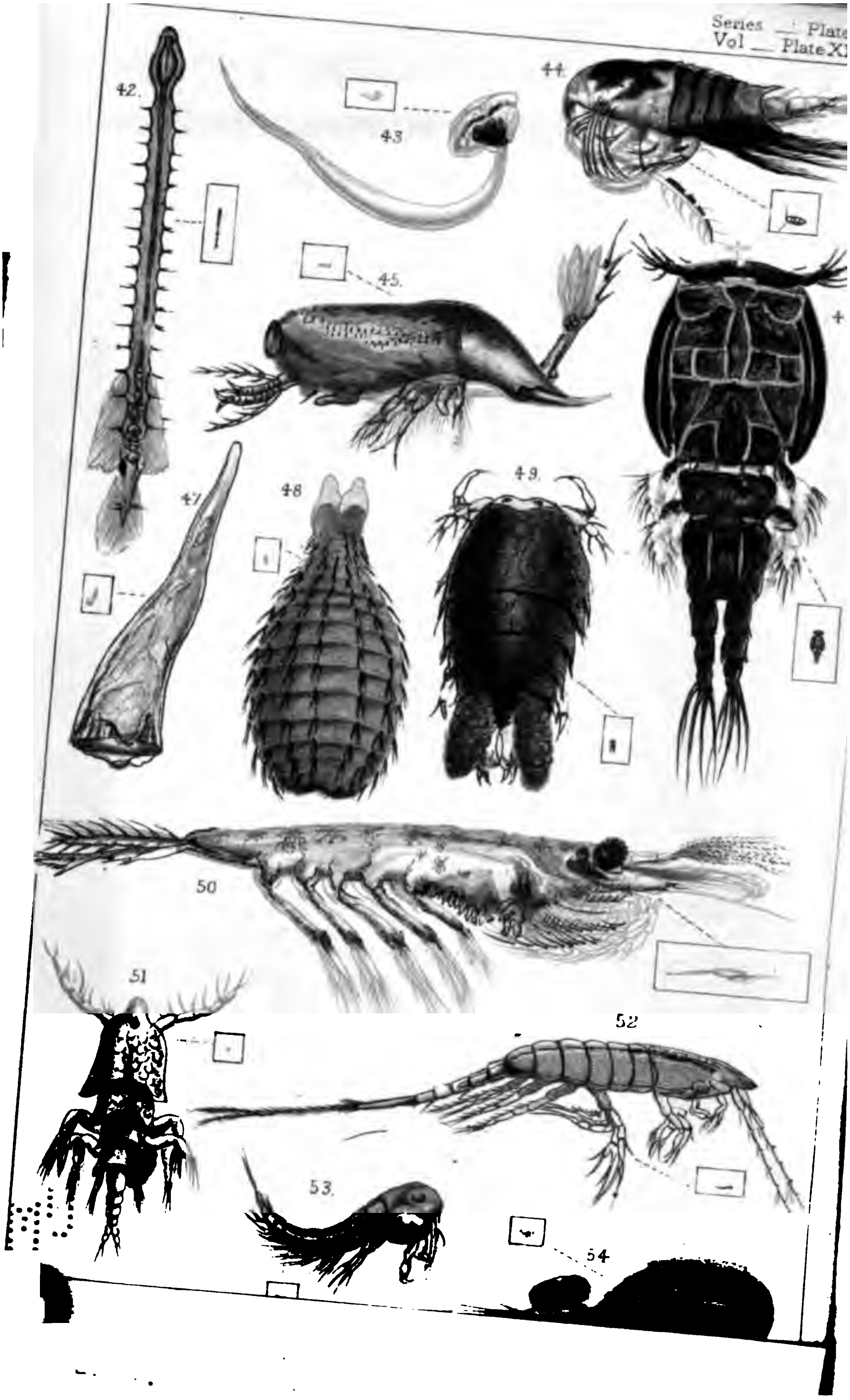


DELINEATIONS OF SOME MINUTE SEA-SURFACE ANIMALS.—From Coloured Drawings by Mrs. Toynbee.

Part II.

For instructions regarding means of capture, examination, &c., see page 214.

PLATE III.

Fig. 25. *Pteropod.*—Feb. 4th, 1868. Lat., 17.11 N.; long., 83.24 E. Current, N. 64 E., 15 miles. This Pteropod flapped its wings and swam about actively, the hairs round the tail were also in rapid motion.

„ 26. Dec. 7th, 1857. Lat., 25.53 S.; long., 82.23½ E. Current, S. 81 E., 7 miles. Temperature of surface water, 72.5°. Found this turretted shell, but was unable to see its inhabitant.

„ 27. May 2nd, 1857. Lat., 9.15 S.; long., 17.19 W. Current, S. 56 W., 5 miles. Temperature of surface water, 77.8°. The long hairs on the horns of this Crustacean and the shape of its head were very peculiar.

„ 28. Sep. 27th, 1857. Lat., 40.17 N.; long., 19.08 W. Current, N. 17 W., 6 miles. Temperature of surface water, 67.2°. Towed the net and caught many of these shells.

„ 29. Dec. 4th, 1857. Lat., 30.17 S.; long., 79.53 E. Current, N. 55 W., 4 miles. Temperature of surface water 68°. Found this flexible medusa?

„ 30. *Pteropod Larva?*—Feb. 3rd, 1858. Lat., 16.21 N; long., 82.37 E. Current, N. 61 E., 14 miles. Temperature of surface water, 78.5°. Found this Pteropod? It had no wings, but arms with actively moving ciliæ, these arms were often extended much farther than shown in the sketch.

„ 31. *Hyalea.*—Feb. 4th, 1858. Lat., 17.11 N.; long., 83.24 E. Current, N. 64 E., 15 miles. Caught this delicate Pteropod; placed in a tumbler of water it swam actively.

„ 32. *Velella.*—Dec. 1st, 1857. Lat., 31.34½ S.; long., 77.24 E. Current, N. 44 E., 17 miles. Temperature of surface water, 69°. During a calm we caught many of these Velellas, its sail was placed at the same angle to the disc, from which it rose perpendicularly, as a ship's yards when braced sharp up. Several of them had shells of Ianthina communis attached to them; others were covered above and below with small barnacles; in these latter the tubes or feelers had entirely disappeared.

„ 33. *Gymnoththalmatus Medusa.*—March 26th, 1858. Lat., 1.08 N.; long., 82.37 E. Temperature of surface water, 82.8°. Found this small Medusa, which, by contraction and expansion, moved rapidly through the water.

„ 34. April 22nd, 1858. Lat., 27.29 S.; long., 52.51 E. Current, N. 2 E., 22 miles. Temperature of surface water, 75.1°. Found this minute shell amongst many others.

„ 35. *Noctiluca?*—April 6th, 1857. Lat., 34.18 S.; long., 25.31 E. Current, S. 49 W., 37 miles. Temperature of surface water, 65°. Towed the net and found it full of these globules; many were examined under the microscope, but this alone showed signs of life by changing its form as shown in the sketch.

„ 36. *Rhizopod.*—Oct. 2nd, 1857. Lat., 20.13 N.; long., 25.43 W. Current,

N. 78 W., 13 miles. Temperature of surface water, 77°. Found this little ball, which had no apparent motion but floated in the water.

Fig. 37. *Nudibranchiata.*—Dec. 26th, 1857. Lat., 1.05 S.; long., 85.13 E. Current in two days, S. 73 E., 58 miles. Temperature of surface water, 81.2°. Caught this Glaucus, which seemed to be of a gristly substance; it floated without apparent motion, but under the microscope the ciliæ moved rapidly.

„ 38. *Beroida?*—Nov. 27th, 1866. Lat., 5.48 S.; long., 81.28 E. Temperature of surface water, 80.2°. It had four rows of very large ciliæ, mouth pedunculated, and an evident stomach. The ciliæ moved most rapidly.

„ 39. *Sagitta.*—May 6th, 1857. Lat., 0.34½ S.; long., 24.47 W. Current in two days, S. 21 W., 38 miles. Temperature of surface water 80.4°. To-day the water was full of these creatures, all with delicate fan-tails, the one in the sketch had moving (by contraction and expansion) up and down its body two slug-like parasitic distomas, which continued in motion after the Sagitta itself was dead.

„ 40. *Atlanta Heteropoda.*—May 23rd, 1857. Lat., 31.39 N.; long., 44.32 W. Current, S. 32 E., 10 miles. Temperature of surface water, 72.3°. This exquisitely delicate shell was perfect, excepting its keel. The part of the interior marked, was in rapid and constant motion, and the sucker-like tube outside contracted and expanded, moving about as if searching for food.

„ 41. Dec. 21st, 1857. Lat., 5.52 S.; long., 81.10 E. Current, S. 31 W., 18 miles. Temperature of surface water, 80.9°. Found this shell, but did not see its inhabitant.

PLATE IV.

„ 42. *Sagitta.*—Dec. 2nd, 1856. Lat., 3.30 N.; long., 88.55 E. Temperature of surface water, 80.3°. Caught this Sagitta? which evidently had vision, as it avoided any object brought near it. It moved by sudden darts through the water.

„ 43. *Appendicularia.*—May 5th, 1857. Lat., 1.35 S.; long., 23.49 W. Temperature of surface water, 80°. It was found in the bucket but was dead when put under the microscope.

„ 44. Jan. 8th, 1857. Lat., 15.43 N.; long., 82.06 E. Temperature of surface water, 77°. In the net was found this remarkable crustacean, which used its black paddles to "tread the water;" its fore legs moved up and down at right angles to the body.

„ 45. *Larva of Copepod.*—Nov. 29th, 1856. Lat., 0.38 S.; long., 83.39 E. Temperature of surface water, 80.8°. Pumped up this crustacean, its eyes were well defined and its tail very remarkable.

„ 46. *Crustacea Copepoda.*—May 9th, 1857. Lat., 3.49 N.; long., 28.02 W. Current, N. 50 W., 30 miles. Temperature of surface water, 79°. This creature was very thin and flat, its shell was marked and coloured much like the back of a tortoise. It was very active and clung to the sides of the bottle and tube.

„ 47. *Annelid Larva?*—March 5th, 1857. Lat., 0.11 N.; long., 82.41 E. Temperature of surface water, 83°. Towed the net and found this substance, which, though motionless, seems to have possessed life.

„ 48. *Beroidæ.*—March 2nd, 1857. Lat., 3.22 N.; long., 82.07 E. Temperature of surface water, 82°. Caught in the net several specimens of this Beroe. The one in the sketch kept its ciliæ in constant motion. Some of them had not so many rows of ciliæ.

„ 49. *Crustacea Copepoda.*—Feb. 28th, 1857. Lat., 4.48 N.; long., 82.20 E. Temperature of surface water, 82.7°. Caught in the net this remarkable Crustacean. The blue appendages are the ova.

Fig. 50. *Crustacea Stomapoda.*
„ 51. April 15th, 1857. Lat., 24.20 S.; long., 62.53 E. Current, S., 2 miles. Temperature of surface water, 77°. In the net found this active little Calanus, with a bunch of eggs attached to it.
„ 52. *Crustacea Copepoda Setella.*—Jan. 25th. Lat., 15.32 N.; long., 82.25 E. Temperature of surface water, 77°. Pumped up this crustacean from about six feet below the surface; its motion in the water resembled the creeping of a small animal.
„ 53. *Miracea Efferata?*—Feb. 28th, 1857. Lat., 4.48 N.; long., 82.20 E. Temperature of surface water, 82.7°. This seemed to creep in the water like No. 52. Great numbers of both sorts were caught; the colours in each case were identical, so also the legs and the position when dead, as shown in the sketch.
„ 54. March 5th, 1857. Lat., 0.11 N.; long., 82.41 E. Temperature of surface water, 83°. Found this crustacean in the net, it had ova attached to its tail; many others of all sizes and colours, but of the same form, were in the net.

The Journal

OF THE

Royal United Service Institution.

Vol. XIX. 1875. No. LXXXII.

Evening Meeting.

Monday, May 3rd, 1875.

Major-General PATRICK L. McDOUGALL, Deputy Quarter-Master General (Intelligence Branch), in the Chair.

NAMES of MEMBERS who joined the Institution between the 27th April and 3rd May, 1875.

ANNUAL.

Smyth, E. G. Selby, Lieutenant, 86th Regiment.
Wyatt, Harry F. J., Lieutenant, R.N.
Woodrow, Alex. K., Lieutenant, R.N.

ON THE ORGANIZATION OF THE COMMUNICATIONS OF AN ARMY, INCLUDING RAILWAYS.

By Lieutenant-Colonel R. Home, C.B., R.E., D.A.Q.M.G.

The subject upon which I am going to address you this evening is a dry one, but its importance is so great, that I feel it requires no apology for being introduced; although I feel that I should apologise for presuming to deal with so large and so complicated a question.

When I was asked to give a lecture at this Institution, I looked through the various subjects that had recently been brought forward, and I found that no one had taken this special subject up. Feeling deeply impressed with its importance, I determined to try and read a paper on it, hoping that other and more competent persons may be induced to follow my lead. Our language is not rich in military terms, and the expression, *the organization of the communications of an army*, is a clumsy one to express what the Germans call "*etappen*"—a word which they have taken from the French *étape*. I know of no English term which expresses what is meant, and therefore I have used a term

which was adopted during the Peninsular, our greatest war, for nearly the same thing. By the words, "the organization of the communications of an army," is meant, therefore, not the maintenance or repair of roads, railways, canals, or telegraphs, so much as the organization which enables an army to obtain the greatest benefit from those means of communication.

When an army advances into a hostile country, it has to be supplied with food, ammunition, and other stores; it has to receive reinforcements in men and horses from the rear; and it has to send back sick or wounded men and horses from the front. If an army of moderate size, say 50,000 men, simply marches 100 miles, without firing one shot, or seeing an enemy, the number of sick that have to be got rid of is very great. Experience has shown that, in a good climate, with abundant food, easy marches, and fair weather, the waste from ordinary causes in a ten days' march of such a force would be between 2,000 and 2,500 men, while the number of galled, foot-sore, or worn-out horses would also be very large. A few wet days or a sharp engagement would raise the number of both very considerably. An inefficient man or horse at the front is a positive disadvantage; he can do no work, and he consumes food which is difficult to get, and often occupies the time of a sound man by requiring to be looked after; consequently, if an army is to be kept efficient in front, there must be a stream of men and horses passing along the lines of communication from the base of operations in the rear to supply the waste in front, and a succession of depôts where sick men and horses may be tended, cured, and again sent to the front.

Further, an army must be fed, and the magnitude of the operation is what many people rarely consider. The action of an army in the field, its marches and its battles, the lists of killed or wounded are what chiefly strike the eye of the looker on; when a man is killed or wounded, or even when he is taken prisoner, his loss is chronicled; but the man is just as much lost if he dies or is invalided from want of food or medical aid. We read of so many killed, wounded, and prisoners, and of so many guns and standards captured; but who notices the losses from privations and hardships? Yet the losses from the latter causes far outweigh those from the former. We read much of the fight at Magenta and the battle of Solferino. Volumes have been written in which you will find accounts of both in the greatest detail; but we rarely see an account of the suffering endured by the French Army from the 9th to the 17th June, 1859; during the first few days the troops were ordered to live on the peasants, and latterly, although in a friendly country, the order was repeated, with the words added, "even to complete exhaustion"—words never used except in the direst extremity.

We read much of the battles round Metz: of the gallant conduct of the soldiers of two great nations; of the skill displayed by the Generals on this side, of the mistakes made by those on that. We read long lists of killed and wounded, but we hear little of the many human lives lost by fever, cold, hunger, and want round, the beautiful city of Lorraine.

Few realize the fact that an army requires as much food as a very

large city. Each day a large city receives its daily supply of food, there is no stint nor stay for those who can purchase; long custom and gradual improvements have opened up easy means of communication between the consumer and the producer. It is different with an army. An army is a city flung down suddenly in the country, each day moving, each day requiring fresh alterations in the arrangements by which food is conveyed from the producer to the consumer. Yet this portion of the art of war—one of the most important, if not *the most important*—receives but scant notice. "War is the art of being the strongest at any given place," and that portion of the art of war that keeps the greatest number of bayonets in the ranks, is surely not to be despised.

It is often asked, why this difficulty about food? The number of mouths in a country is but slightly increased when two armies meet; the total number of mouths in the two countries at war is really diminished. Why then this difficulty? The answer lies here. Suppose there are 10,000 bakeries in England, an addition of ten mouths to be fed by each would make but a slight difference, if distributed. But suppose the additional 100,000 mouths all concentrated in one place, and requiring to be fed all at once, the circumstances are altered.

There are really but three ways by which, or by modifications of which, armies can be fed in the field:—

1st. The soldiers may obtain food by being billeted on the inhabitants, or by living from hand to mouth as they march.

2nd. The whole of the provisions may be carted after the army.

3rd. The army may be fed from magazines.

Let us consider these three methods. In the first case, the army would soon cease to be a military body; the men would quickly become a mob of marauders, and cease to be an army. In a thinly peopled country, moreover, the dispersion of the men in search of food would be so great that little or no progress to the front could be made, and the moment a halt took place, the troops having exhausted the district where they were, would simply starve, precisely as a bullock tethered by a string will eat up everything in its circle and, if not moved, die from starvation, even in the midst of a rich meadow. This was the system generally adopted by the great Napoleon; it is one which we do not read much about in ordinary military histories, and into which we only get an insight by reading personal narratives of the wars at the beginning of this century. And it must be confessed, that the genius of Napoleon as a strategist and tactician appears all the more marvellous when the system under which he made war is considered. The marches made by the French Army Corps to blockade Ulm were made in this manner, and French writers say the men suffered severely for many days. Pillage showed itself in that, the finest army Napoleon ever commanded. This must be the invariable result of there being no magazines. A victorious army may march on a broad front in a rich country in such a way, but the moment it concentrates to fight, or halt, it is plunged into the greatest difficulties.

After the capture of Berlin in 1808, when the French undertook the winter campaign in Poland, their sufferings were very great; whole

corps disappeared, broken up into bands of marauders seeking food in the scattered farms of that inhospitable country.

The serious check received by the French Army at Eylau, was caused by the demoralisation consequent on this system. The resources of a country cannot be utilised by an army marching through it; they are wasted and lost.

We now turn to the second method, that by which an army is fed by provisions carried with it on waggons; this is possible for a very small force, but for a force of any magnitude it is impossible.

The Comte de Paris has furnished a remarkable calculation on this subject. He says, one road will suffice for only a limited number of carriages; if several roads are available, the number of waggons must be limited, otherwise the army cannot move.

A six-horse waggon will carry 2,000 lbs.; and the supply for each man per day, medical stores, ammunition and food included, may be placed at 4 lbs. per man.

Such a waggon will supply 500 men for one day; but if the army is a day's march from its base, it will only supply 250 men, for it must go back empty to re-fill at the base. If it is two days from its base, 4 waggons for 500 men are requisite, or 8 per 1,000, or 800 waggons for 100,000 men. But if the army of 100,000 men, includes as it would do, 16,000 cavalry and artillery horses, 200 waggons would be requisite to carry a day's forage, or 800 if the army was two days march from its base; or 1,600 waggons, horsed with 9,600 horses, but these waggons would be three days away from the base and one day there, consequently they would require 360 more waggons, horsed by 2,460 animals, to feed them; these would require 92 additional waggons, and so on, until we arrive at a total of 2,000 waggons, horsed by 12,000 animals, as being absolutely requisite to feed an army of 100,000 men two days from its base of operations. If the army advances one day further, or three days march from its base, it would require 3,760 waggons, horsed by 22,000 animals, a column 38 miles long if the intervals could be kept; but which would extend over 48 miles or the whole four marches; and even this number of waggons does not give a true picture, for there must be a fresh set of waggons to carry the food from the divisional depôts to the regiments. To move ten days from the base of operations, on the basis furnished by the Comte de Paris, would require 10,975 waggons, horsed by 65,850 horses. This is a number which it would be practically impossible to deal with, covering no less than 108 miles if the distances be kept, but which would really be more than the whole length of the ten days march.

The third method, or that of magazines, is consequently the only sure, safe, and possible means of making war, provided it be judiciously combined with a system of requisitions.

Along the roads, railways, or canals forming the line of communication of an army, there must be two distinct streams always flowing, viz., that which supplies the army with fresh or convalescent men and horses, as well as food and warlike stores of all kinds (this stream flows from the base to the army), and that flowing in the opposite direction, which carries back sick and wounded men, horses, and

prisoners, either to depôts on the line of communication, or to the base itself, and also the empty waggons returning for fresh supplies.

It is manifest that there must be some organization which shall keep order and discipline amongst the heterogeneous masses which compose these two streams; which shall form depôts in proper places; see to the supply of the sick and wounded; push on what is urgently wanted; economise and utilise the resources of the country whether friendly or hostile; direct those resources to proper places; maintain and repair the telegraphs, roads, railways, and bridges; garrison important points; protect and patrol the communications; check disorders; look after the dispatch of letters; and lastly, be such, that with but a short delay, can direct the whole of the vast traffic into another channel, should the movements of the army necessitate this being done.

This organization which the Germans term *etappen*, and which I have paraphrased as the "organization of the line of communications of an army," is that portion of the military art where study and forethought come most into play. It is that portion of the science of war, where the bright scintillations of genius, the sudden inspirations of the heaven-born leader, can do little or nothing. But it is on that account the more important; as careful, accurate, painstaking, study, and forethought applied to it, will go far to remove many of the indeterminate causes which mar the most brilliant schemes.

In war there can be nothing absolutely fixed, nothing rigorously systematic. But while this is true, it is equally true that the military machine is composed of many different parts that cannot be made to work for one end unless they all fit into a well arranged scheme. If all the details of such an organization be not clearly sketched out, well understood and thought over by every one, no amount of inspiration or feverish excitement will make things go straight when the machine is tried.

I quite concede that such an organization can only be tried in actual war, cannot be exercised in peace; but granting this, I believe that if the principles of such an organization be clearly laid down, and the functions of each person well understood by all concerned, the organization itself will quickly get into working order when wanted.

While then rigidity of form is inadmissible, yet it is desirable to have a standard or model, to reach which, every exertion should be made, even although such a standard may never be reached. It is very desirable in this matter, as in everything else, to establish some definite and clear principles of organization; details, however important, quickly arrange themselves if the framework or sketch be based on sound principles.

The first great principle which I believe modern experience has pointed out, is the division of the whole subject of supply into two great branches.

1st. That which works in rear of the army.

2nd. That which accompanies the army.

These two great branches should be perfectly distinct, their functions are different, and the class of men and conveyances to be used is in each case different.

The function of the first is to look after and forward stores massed in large depôts, and to push them up, as far as possible, after the army. Referring to the illustration of the bakeries in England, it is the duty of the organization in rear, to seek out, as it were, the food which each soldier would have eaten if he had remained at home, or in garrison, and to send it after him.

The function of the second is to bring up the food from the advanced magazines to the divisional depôts, at every opportunity, more especially during halts, and at the same time to seek to utilise the resources of the country by requisitions in the immediate neighbourhood of the marching troops.

It is manifest that the service in rear may be of a semi-civil character, the transport may be by rail, hired vehicles, or canals, while the service in the front must be military, and must be performed by bodies having a military organization. As an army advances into a hostile country, the requisitions in the immediate neighbourhood of the line of march will have, to a certain extent, exhausted the country; one object then of the semi-civil organization following in rear, will be to extend the area of requisitions, and to tap fresh supplies. In every case the furthest advanced point of the department working in rear should be as near as possible to the army in front, should follow it, and keep, if possible, within one or two marches of it, relieving the guards and detachments left in rear, completing any work that may have been done by the advance, strengthening bridges, repairing roads, laying telegraphs, and bringing up supplies. The transport working in front must, to prevent confusion, be under perfect military control, and must be able to bring up the supplies from the rear, that is to say, from the head or advanced portion of the rear-organization to the divisional depôts.

The food or supplies, however, have to be carried from those divisional depôts to the regiments themselves, and a fresh organization is requisite for this, which, being responsible for the supply of the units within the division, that is to say, the battalions, batteries, and regiments, must be a part or portion of these battalions, batteries, or regiments themselves.

Thus we are led to a division of transport into three portions, and I beg, gentlemen, to draw attention to this division, for in it I believe lies the key of success in this branch of the art of war, a division of transport into—

1st. General transport, embracing railway, canal, and road transport, working along the line of communication from the base to the most advanced magazine.

2nd. Departmental transport, which shall convey the supplies from the advanced magazine to the divisional depôts.

3rd. Regimental transport, which shall bring the supplies from the divisional depôt to the battalions, batteries, or regiments.

Accuracy of detail and economy of power are only to be found in an intelligent division of labour. By such a division of the transport, the smallest portion is that which, having to be always close to the troops on all roads, and even in the fields, must be highly organized

and well horsed. The Departmental transport, which need not move so rapidly, and generally moves at night, and always on roads, may carry heavier loads, or, what is the same thing, may use fewer horses, —while the transport working on the line of communication may, if it is not railway transport, be waggons hauled by relays of horses pressed from the inhabitants, and working a stage close to their own homes, thus avoiding the necessity of sending men and horses to the front, and further, relieving the magazines of the task of feeding horses and men so employed. The first description, General transport, must be under the Commandant of the line of communications, and under him alone; the second description, or Departmental transport, must be under the heads of departments—artillery, engineer, and commissariat; and the third, or Regimental transport, must be under the officers commanding regiments. When I say the transport is to be under these different directions, I mean not that the horses detached for any one service are invariably to be so employed, but I mean that these are to be their normal or general duties; it being always distinctly understood that any horse or any man in an army is liable for any duty the General commanding may choose to order. It would appear almost needless to say this, but it used to be an axiom in the French army that the "intendant" was responsible for the supply of food, the commanding officer of artillery for that of ammunition, and the commanding engineer for intrenching tools, each having his own train, while the general was responsible for handling the troops in action. This led to its natural results, the heads of each branch of the service rarely helped one another, and the general, shorn of half his attributes, lost his power. In an army-corps, division, brigade, or regiment, the commanding officer is alone, and can alone be responsible, for not only handling, but also for supplying the wants of his men. He may, and doubtless must have persons under him responsible to him for carrying out certain duties, but their responsibility is to him, and to no one else.

Many of the arrangements adopted in foreign armies, and which are too often supposed to be modern discoveries, will be found to have existed under different names and altered circumstances, in the Peninsular War. Wellington began with no organization, but originated as he went along, and his organization, adopted from experience, was in principle almost identical with what now holds in the German army. It is well worthy of study as given by Gurwood.

These were—1st. The regimental mule equipment (pack animals, to follow the troops through the difficult country they had to traverse in Spain). 2nd. The departmental transport, represented by the artillery train, the engineer train, and the commissariat train. The two first chiefly, though not altogether, composed of the corps of artillery drivers, and the latter composed chiefly of the Royal waggon train, while the general transport was represented by vast numbers of hired carriages and animals, comprising the ordnance and commissariat transport, and by boats on the Tagus and Douro, worked by seamen; the whole of the latter being under the general direction of the officer in charge of the communications. Allowing for the altered

circumstances, and the absence of railways and telegraphs, the system used in the Peninsula by Wellington was very similar to that now adopted in Europe, with, however, one important difference, to which your attention will be shortly directed.

Viewing then the question generally, we arrive at this point, that if an army is to be kept up to its fighting-strength in front, the communications must be worked by an organization separate and distinct from that in front. It is by no means meant that this organization should be distinct from and independent of the general commanding the army, far from it; the organization working on the line of communications should occupy the position, as regards the army, that an army-corps does, that is to say, the officer in command of the communication should hold to the general commanding, the position that an army-corps leader does. This is most distinctly laid down in foreign armies. If an army corps is working by itself it is really composed not of two, but of three divisions—one taking charge of the line of communication, and not being classed or counted as troops of the fighting line; similarly, if several army-corps forming an army are working together, there is another on the line of communication not counted or classed with the fighting troops.

Now this is the point where the modern foreign organization differs from that of Wellington, a difference undoubtedly caused by the small force at Wellington's disposal.

He was obliged to endeavour to look after his communications by means of detachments and convalescents—the results were constant abuses. We read continually in the pages of Napier of the cavalry regiments being dangerously weakened by detachments acting on the lines of communication really as military police. We read of constant abuses, arising from convalescents being detained in rear, and the fighting battalions in front being thereby weakened. Now in modern armies, the force told off for the communications is complete—it has its own battalions, its own commissariat, artillery, and engineer staffs, which hold to the heads of those departments with the army, the relations that similar officers do in divisions to the senior officers of those departments. Thus the troops in front are never weakened by detachments, and a division of 10,000 men on paper is really as nearly as possible of that strength on parade. The advantages of this as regards discipline are enormous—units such as regiments or battalions are not broken up to find garrison for this post or that important railway junction.

There is nothing more remarkable in examining from time to time the strength of the Prussian army in France than to see how closely the real strength of each corps corresponded with the regulation strength.

The advantages of doing away with detachments is too well known to require to be dwelt on here.

Indeed, if an army were to advance into a hostile country without such organization, it would soon reach the end of its tether, the fighting men in front would be gradually disseminated along the whole line of communication, and nothing would be left in front with which to meet the enemy.

In every army, there are and must be a very large number of semi-military bodies, that is to say, bodies possessing a certain amount of military organization, and yet whose function is not to fight but to work for those who do. These bodies are invaluable; but in front, their presence is absolutely hurtful; in rear, their duties are all important. Amongst these bodies, are the bakers, the butchers, the great mass of the telegraph corps, the railway corps, and a large proportion of the medical department. Further the protection and guard of the various posts in rear may be given to troops, inferior in marching power to those in front, and consequently we are again brought by another set of reasons to the fact that a separate and special organization is required for the line of communications.

Nothing more clearly demonstrates the value and importance of a careful preparation of these details, than the Franco-German war. Prussia conquered France, not so much from valour on the field of battle, as by the most painstaking care in every detail.

As the Prussian army advanced, it drew Prussian civil institutions after it; and the French statement, that France was invaded not by the Prussian army but by the whole Prussian nation, was literally true. As a general statement, it may be said that the collection of supplies at the base of operations is really the work not of the military leaders so much as of the civil administration of the State.

Acting on this idea, Coblentz, Mayence and Mannheim were the bases, or great depôts of the German armies at first; stores were accumulated at these places chiefly by the civil government, organized bodies in charge of the communications worked from those points to the army; gradually as the army advanced, these semi-military bodies followed; and were in their turn followed by a civil organization. First, a Governor of Alsace was appointed, next a Governor of Lorraine; and each functionary exercising the civil government of the State, allowed the semi-military bodies in charge of the communications to be pushed to the front, and finally the grand depôts originally on the Rhine, were pushed to the Moselle, the force in front thoroughly military, gradually shading off along its line of communication to the civil governors of the various provinces in the heart of Germany, where each corps had its home and peace station. The young unmarried men were in front, fighting and exposed, the older and married men in rear, each in proportion to his age and his power, doing his country's work.

To place highly trained military bodies to guard communications, to see after the police duty, to prepare relays of horses, or convoys of stores, is manifestly a waste of power. Looking to the two recent campaigns of 1866 and of 1870, it appears that in this organization the Prussians showed their superiority more than in anything else, the whole power of the State being devoted to one object. The Military Estimates in peace maintained the fighting men, and but a very feeble nucleus of these semi-military bodies; their peculiar institution of universal service enabling them to put their hands on as many men as they required at a moment's notice.

Thus when war broke out, every man in the country found his place

in the vast machine by which the fighting men in front were kept supplied. The French army had no such organization; and was so frittered away in detachments, and there was so much confusion, pillage, and waste in rear of their army, that, taught by experience, the new French military laws provide that men, who from their stature, or from some slight physical infirmity, are not placed in the ranks, are enrolled for these auxiliary branches of the army.. In war, the more complex the military machine becomes, the more important becomes the moral power of armies; and I would venture to observe that armies only get more complex, because society itself gets more complex; because discoveries and inventions introduced into civil life are adopted into armies, because, in short, men are better educated, and the general standard of knowledge is everywhere higher, consequently moral force, as a lever that sways bodies of men of the size of modern armies, is more important now than when Napoleon said it was three times as important as physical force. Nothing tends to preserve moral force in armies so much as well ordered communications. It is not merely that regular supplies of food are brought up, that the men are regularly fed—although that goes for something—but the sick and wounded are got out of sight rapidly. Men's minds are not allowed to dwell on horrors, and above all, the reinforcements coming up from the rear, seeing regularity, order, and strict discipline in the rear of the army, are impressed with the sense of the power of the whole machine at work, and spread a healthy tone through the ranks they join.

It has often been said, and with great truth, that German military institutions have not been tried by defeat, that a concatenation of peculiar events has helped Germany in her great successes. This most undoubtedly is true; but if we examine her military institutions, we shall find that her leaders take precisely this view, and they have striven to produce a system that shall be available in the day of defeat as well as in that of victory; and nowhere is this anxious care more evident than in the organization of communications.

The service working in rear must therefore have a special and separate organization. In Germany (France and Austria have followed German arrangements to a great extent) there is an officer who commands the whole line of communications; his place is with the General commanding, or one march in rear of him, and under his orders he has six distinct branches working.

1st. The route service.
2nd. The railway service.
3rd. The field intendance or commissariat.
4th. The field medical depôt.
5th. The route telegraph.
6th. The field post office.

Each of these departments has its own head, and each is of a civil, or quasi civil character. Each has its purely military branch in front.

The Telegraph department is a good example of the way in which the civil shades off into the military.

It is divided into three distinct branches all under one head.

1st. The State or home telegraphs.

2nd. The route telegraphs along the line of communication, usually a light, overhead wire.

3rd. The field telegraph-detachments which communicate with the division and army corps. The latter being under the Generals commanding, the Director of military telegraphs deals with them through the generals.

As the army advances, the route telegraphs are rapidly laid, and the first, or State telegraph-department, follows and completes the work, connecting it with the general telegraph-network of the kingdom the Director General of State Telegraphs having as his assistant, or deputy, the Director of Military Telegraphs.

Thus there is no attempt to spread the field-telegraph-detachments out along the line of communications; being well horsed, and an entirely military body, their functions are to make a line each day to unite the divisions, a line that must be rolled up and re-made the next day. The route telegraphs are more permanent but less military in their character, the great object being to push the State telegraph as rapidly as possible in rear. Thus by a proper division of labour, the actual number of soldier-telegraphists is but small, and the money spent by the State on soldiers is thus kept as much as possible to pay for actual fighting men, those who work in rear, being, on account of their prospective service in this way, relieved of a certain portion of the service they otherwise would have to do in the ranks. Men so employed do not require periodical training as soldiers, they do not require more than a distinctive dress and a habit of respect for superiors. I do not now propose to attempt to describe these six divisions or branches of the communications of an army, but I cannot dismiss the second, or that of field railways, without saying a few words on this very important special branch of the subject.

The use of railways has introduced great changes into war, and it is believed that these changes may be summarized somewhat as follows:—

Viewed strategically, they have given an enormous power in concentrating masses of men and horses from the distant portions of a country on certain points; such concentrations in short as those effected by the Germans in 1870, on Coblentz, Mayence, and Mannheim. Viewed tactically, their use is restricted. Armies may be massed by these means at a secure distance from an enemy in a short time; but the moment that the distance between two contending armies becomes such that a powerful force must be ready to form in line of battle to meet an opposing army, the railway becomes for the purpose of moving troops of little value; but for the purpose of supplying troops, and removing sick and wounded, its value is at all times very great. Although universal compulsory service is more than sixty years old, I think we may fairly doubt the possibility of keeping the vast armies in the field that are thus placed in it, if railways did not exist. Suppose there had been no railways during the recent Franco-German war, I think it is exceedingly doubtful if Germany could have kept

400,000 or 500,000 men in the field. No amount of waggon transport would have fed them in France; and if such a force had attempted to advance, feeding on the country, it must have spread over so wide a front to seek subsistence, and its power to concentrate would have been diminished to such an extent, that its numerical value would have been greatly reduced.[1]

Railways must, therefore, be viewed in two distinct lights:—

1st. As means for concentrating armies from distant points, and for placing them on the theatre of war.

2nd. As means for supplying those armies while operating on the theatre of war.

This division is really that between railways actually in the zone of military operations and outside it.

In the former case the military element predominates; in the latter, the civil.

It is manifest that there must be a line of demarcation between these two. This the Germans term the transfer station. Take, for instance, the advance march of the Germans from the Rhine towards the Sarre. The Rhine was for some time the dividing line, Mayence, Manheim, and Coblentz being the transfer stations. East of these points the civil element prevailed; west, the military element was all powerful. The object being, as the army advanced, to push these transfer stations after it as quickly as possible, they were moved first to the Moselle, and subsequently to the Meuse, in each case the civil railways of the State extending their field of operations further to the west, and allowing the military organization to follow the army. The reason of this distinction is, that an army in the field depends for its supply on the productions of the country in rear of it, and it becomes essential not to dislocate the means of production, and to interfere with the trade and commerce of the country as little as possible. At the same time it is requisite that for a certain space in rear of the army it should have complete control over the railways; hence, a station must be selected where the separation takes place. The French made no such separation; and the consequence was that all kinds of stores, men and horses, were sent from all France to the army when actually in motion, there being no halting place out of the immediate zone of action, where the mass of supplies so sent could be arranged and forwarded as required; consequently the railways immediately in rear of the army were blocked and useless, and the waggons containing the things that really were wanted, never could be got at. I know of no more extraordinary description than that of the blocks of railway carriages in rear of the French Army at Le Mans, or in the town of Metz.

At the latter place nearly 7,000 carriages were blocked together in a solid mass; none of the people on the spot knew what the waggons contained—ammunition, food, clothes, arms, intrenching tools,

[1] The invasion of Russia by Napoleon is a case in point. Many writers have carefully examined this great episode, and all agree that no organization of carts or waggons could have fed so great a force so far from its base, but that a single line of railway would have done so with ease.

pontoons, and hospital arrangements, being mixed up in a confused mass—the power of the railway as a carrying agent being destroyed by its carriages being used as moving magazines. Had a transfer station been used, much of this confusion would have been prevented.

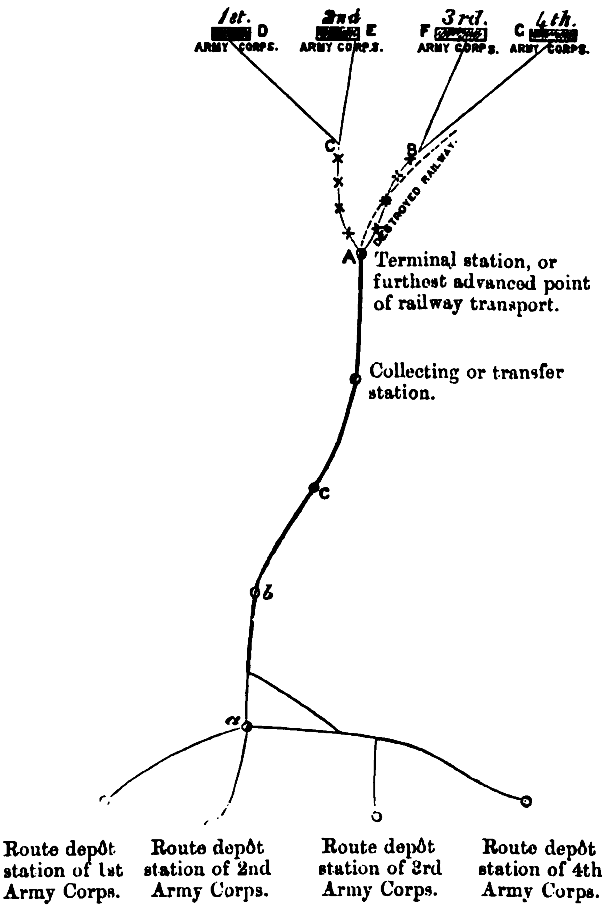
There is always a tendency to follow the lead of those who have been successful, and consequently since the successes of Prussia, there is a great tendency to Prussianize military matters. There is danger in this. There can be no doubt that, broadly speaking, the principles of war must be the same in every country, precisely as the principles which govern the administration of justice, the principles of music, painting, sculpture, &c., amongst civilised nations are identical. But each nation works out those principles in a different way; and any one who is a judge, will tell a French picture from a German, French music from German. So it must be with war—the principles which each nation has to deal with are identical. But in working those principles out, the peculiar idiosyncrasy of the nation must come into play. The outline of the picture in each case will be the same, but the colouring and detail will vary.

I am far from thinking or urging that we should adopt German customs in this country. But it is well to see what German customs are, and how the Germans have worked out the problem of utilizing their railways. When paying a visit to a German officer who filled an important position in a large fortress, I saw a table which looked like a kind of Bradshaw, and on asking what it was, I was told it was the annual mobilization table. "See here," my friend said, "if we will "have war, and to-morrow is the first day, I know that at four o'clock "a train containing so and so will arrive, at half-past five another, and "so on, for the nine days during which the operation of mobilization "takes place." And he told me that each year this table was altered, and every officer of certain grades had a copy of it. This table is really a very simple affair. An army is composed of men, horses, and stores; those men, horses, and stores, must in peace time be in certain known places. In war time they must be concentrated in other known places. Consequently it becomes a matter of simple calculation to determine where each of the scattered bodies or units can be best embarked in the railway waggons, and the time it will take to reach its point of destination. The table of mobilization is merely the result of a careful study of the subject. In Germany, a section of the Head Quarter Staff, aided by the Government Inspectors of Railways, prepares these tables and prepares a Bradshaw, which in war takes the place, while the army is concentrating, of the ordinary Bradshaw; certain of the ordinary trains ceasing to be civil and becoming military, and additional trains being added. On the completion of the mobilization, the railway section simply directs what trains are to run as military trains, and all the rest work as usual.

Further, as every unit has its fixed head-quarters, so each army-corps has its head quarters. And it is one of the functions of the railway section of the General Staff, aided by the Railway Inspectors, to select for each corps what is termed a "route depôt station;" to this

station everything belonging to the corps is sent, whether going to it, or coming from it.

These route depôt stations have each a commandant, they are selected after careful consideration, and if plenty of store and plat-



a, *b*, *c*, important points which should be the head-quarters of the railway working commission.

A, B, C, road transport by waggon to the route termini B and C, C D, C E, B F, B G, the lines on which the departmental transport works feeding the Army Corps from the route termini B and C.

form-accommodation does not exist, during peace, it is made; at this station the commandant is supreme.

Further, in peace-time a committee for each line, consisting of the traffic manager and a military officer, is appointed. The duties of this

committee are the following:—In case a country is plunged into war, there can be only a limited number of possible contingencies. These contingencies are determined carefully. The route-depôt station, and the places to which the troops and stores are to be moved, are also determined. The line committee determines where halts have to be made, where men and horses are to be fed and watered, and on single lines the passing places for trains. These points are all clearly laid down, and every one knows them. The commandant at the depôt station simply loads the men, horses, and stores he receives from the district of the corps; the line committee take charge of them and deliver them at the transfer station. It is manifest that the whole of these arrangements require nothing more than a little care and forethought, and a mixture of railway knowledge and military knowledge on the part of those who make them. There is no science required at all. Let us suppose for a moment that Scotland was a foreign country, with whom we were as likely to fight as we once were. And suppose we had 30,000 men stationed in Hampshire and Dorsetshire, 30,000 in the Midland counties, and 30,000 in Kent. The first step towards a mobilization of these forces for a Scottish war would be the selection of points of concentration for each body of troops; the determination of a route; depôt station; a detail of how the men, horses, and stores should get to that station; and the selection of a line of railway over which each corps was to move; the appointment of a line committee, consisting of military officers and the traffic managers of each line affected; and the determination of certain fixed trains to be used for through-traffic, and also certain places where men and horses might be fed, either breakfast, dinner, or tea, say six hours after starting. These conditions are clear and definite, and require only a little time to arrange. But where are these trains carrying all these men and stores to go to—where will you disembark your loads? Here we come to one of the most difficult problems to determine, and one on the correct determination of which, much depends. Are the Scotch likely to be more advanced in their preparation for war than we are? What is the political state of the country? What is the character of the leader, is the war popular, have they many railways to concentrate their troops with? All these questions enter into the determination of this point. It is manifest that if the point of disembarkation is chosen too far to the front, the troops and stores coming up in a long column by rail are liable to be greatly inconvenienced, perhaps not by the actual attack so much as by the threatened attack of the enemy.

If the point is too much to the rear, the full value of the railways will not be obtained, consequently the determination of this point is one of the greatest importance. Let us suppose York is the station selected, then that station becomes the transfer station or collecting station.

Behind that, all transport is worked as described under the regulations prepared carefully beforehand, as much as possible peace-traffic is maintained, and after the first concentration of troops takes place, certain military trains only are run. The points of departure and

the point of arrival once fixed, the concentration of troops becomes a simple matter.

Beyond York, no civil traffic of any kind would be allowed, and a military railway director, with very extended powers, would be appointed to work all the railway traffic north of York, acting, however, always under the orders of the officer in chief command of the communications. But let us carry our arrangements a little further, the Collecting Station, York, becomes then at once a great store.

The troops as they arrive are pushed through it at once, some by rail, some by road, towards definite points, where each of the three corps coming from Kent, Hampshire, and the Midland counties would be formed. The station at York would be placed under a commandant, who would issue orders somewhat similar to the following:—

"No trains containing military stores are to pass York."

"Trains with troops and ammunition may, unless specially ordered, pass."

"No train will go to the front that is not full."

"All provision trains will be unloaded, except in special cases, when definite instructions will be given."

"All trains coming from the army will run past York and not stop there."

Meantime, let us suppose that the Commissary-General of the army in front finds, or thinks he will find, difficulties in feeding the troops, on account of some flank movement that is going to be made against the Scotch army. He notifies the commandant of the line of communications of the quantity of provisions he is likely to require suddenly. These are loaded up, formed into trains, and pushed into sidings a few miles north of York, with a small guard which encamps beside them; a telegram from the front brings them on at once.

Similarly an action is expected, and hospital trains are formed, placed in sidings, with nurses, medical comforts, and a guard; a telegram brings them to the front at once, and the sick or wounded are carried far past York to the south.

North of York, the traffic would be entirely military, and worked under a military railway director, who would have under him a proper staff for that purpose, and who would arrange for all the traffic being worked in a regular way. But how far can such traffic be worked? How close to the army can the railway transport be brought up to the front? The answer to these questions depends on many things:—

1st. The line, is it destroyed or likely to be destroyed?

2nd. The nature of the stations available as terminal stations.

3rd. The prospects of a collision with the enemy.

4th. The nature of the roads and the horse-transport of the army corps.

5th. The situation of the army as regards the railway, and the front it was occupying.

But let us suppose a station selected, we will say Darlington, the enemy's army being somewhere in the neighbourhood of Newcastle.

Beyond Darlington, railway transport would, except in special cases, cease, and each army corps would have to send its departmental transport to Darlington for supplies. Darlington, the route-terminus, would be the point where the organization of the line of communications would cease; it would be the great point where distribution would commence.

Let us suppose, however, a little further, that the railway has been destroyed north of Darlington, and that the enemy, the Scotch, retreat; the army advances, and the distance from the route-terminus to the corps becomes too great for the departmental transport to work. The officer in command of the communications foreseeing this, and knowing the direction the army is marching in, fixes a fresh route-terminus and establishes a line of horse transport from the railway-terminus-Darlington, to the points he has selected; to these points the departmental-transport now send for supplies, the transport of those supplies to the route-terminus, resting with the officer in charge of the communications, while a strong body of workmen would be put on the railway to repair it, and relay the rails, when the railway terminus would be again advanced, and so on. At the Collecting Station, York, supplies would be sought, not only in the south, but in the whole region round York, and each commissariat officer of the army-corps would seek by requisitions purchased, or other means, to relieve the strain on the communication as much as possible.

Such I believe to be the principles on which the Germans work railways, and undoubtedly so far as we can judge by the application of cause and effect, they are correct. I have tried not to burthen you with details, nor to enter into descriptions of how the complicated arrangements requisite for the organization of lines, may be best divided between the departments of the army. If the principles are sound, the details will quickly settle themselves. But this we may feel sure of, that though good men may make bad systems work, yet all systems should provide for being worked by mediocre or indifferent men; many details of the German regulations, however, do not appear to me to be so framed,—I say it with the greatest diffidence and submission. But the general principles which prevail the whole, are logical, clear, and definite, and I cannot better conclude than by quoting the opening words of their new regulations on this subject.

"The regular working of railways is of the first importance, not "only for warlike operations, but also as most materially affecting "national interests. The greatest care should be taken that they are "regularly worked; on the lines in rear of transfer-stations, the "ordinary traffic will not be interfered with for military purposes, "except when absolutely requisite. As a rule the ordinary public "trains will run, extra ones being added for military purposes. The "carrying powers of a railway are best developed by constant steady "traffic at regular intervals."

"Any interference with the regularity of the railway is fatal."

The CHAIRMAN: I trust I may be allowed, in the name of this meeting, to assure Colonel Home that the subject which he has treated to-night has been neither

tedious nor uninteresting, and I hope I may be allowed to thank him in the name of those who have listened to his lecture, for the instruction which he has managed to convey in so interesting a manner. Genius has been defined as a "vast capacity "for taking trouble;" and although I do not think that is by any means a correct definition, there can be no doubt that success in any enterprise, or any line of life, depends on a vast capacity for taking trouble; and I believe that the successes of the German armies in the two last wars were not so much owing to the manifestation of any great military genius on the part of the different generals, as to the vast capacity for taking trouble which was displayed in the bureaus of the military offices of the empire in anticipation of war, no branch of which is, probably, more important than that which Colonel Home has brought before us so ably to-night.

Colonel CHESNEY, R.E.: I should like to give one single illustration of the value of the system which Colonel Home has so ably explained, of which I happen to have gathered the particulars on the spot, when visiting it on behalf of our Government at the close of the war. It occurred at a part of the siege of Metz that there were some comparatively slight but still smart actions, partly by reserve troops hurried up soon after a great part of the army that had been round Metz, moved on towards Paris. Among these reserves were some from Wurtemburg. They came up not very long after the investment of Metz was complete, and almost immediately were brought into action; some of them had only just arrived. I learnt that they came into action, were wounded, and were conveyed by railway to the hospitals at Stuttgard, after a journey of less than twenty-four hours; so that it was affirmed that they were actually only thirty-six hours from the time they came before the French until the time they found themselves again in the heart of Germany, lying in their own town hospital. I suppose there can scarcely be a more striking instance of the value of perfect railway-management in maintaining unbroken the communications of an army with its base.

The CHAIRMAN: I am sure you will allow me to return your thanks to Colonel Home for his very valuable lecture.

Evening Meeting.

Monday, April 5th, 1875.

MAJOR-GENERAL R. C. H. TAYLOR, C.B., Inspector-General of Recruiting, in the Chair.

NAMES OF MEMBERS who joined the Institution between the 15th of March and the 5th of April, 1875.

LIFE.

Badgley, W. F., Capt. Ben. Staff Corps.
Bewicke, C. T., Lieut. R.N.
Boulderson, Samuel, Capt. 17th Lancers.
Fisher, E. D., Capt. 4th Hussars.

ANNUAL.

Gunter, H., Capt. 73rd Regiment.
McCoy, Washington, Lieut. South Devon. Militia.
Hoole, James, Lieut. 5th W. York Milt.
Lodge, J. W., Lieut. 5th W. York Militia.
Montagu, Andrew, Lieut. 5th W. York Militia.
Skrine, H. M., Major 1st Som. Rifle Volrs.
Underwood, P. C., Lieut. R.N.
De Schmid, H. W. F., Capt. South Devon Militia.

ON TRAINING BOYS FOR SOLDIERS.

By JOHN MACGREGOR, Esq., M.A., Chairman of the Industrial Schools Committee, of the London School Board.

THE following letter appeared lately in the "Times:"—

"Recruits for the Army.

"To the Editor of the 'Times.'

"Sir,

"Why not train some boys for soldiers while other boys are trained for sea?

"Of the 8,000 boys in certified industrial schools, who must leave at 16 years of age, some hundreds at least would become soldiers, but they may not enlist until they are 18 years old, except as band boys. Many of these are Irish, who prefer the camp to the forecastle, while their patrons object to send them as band boys for reasons I cannot specify here.

"Bridge the two years of interval by opening a 'cadet school' at some military centre. The industrial work of lads properly selected would pay for a great part of their keep. Their *physique* and educational, moral, and military training would be far above that of the average recruit. Of the 2,000 other boys in refuges, and hundreds of outsiders in private life, many would be attracted by a 'Boy Brigade,' and often friends would pay.

"At present, we close the door to the Army until an age when all these youngsters have diverged to uncongenial, overstocked trades. Then, two years later, we purchase their service for the Army at a

high price, and then wonder that they desert and fill military prisons, or retire to fall back upon handicrafts which they know enough to trust to and not enough to live by." * *—*Dec.* 1874.—J. M.

We are met to consider the following question:—"Why not train some boys for soldiers while other boys are trained for sea?" and I have been invited to state why we *should* train boys for soldiers, and how it may be done so as to be good for the Army, the boys, and the nation.

Now the value of any person's opinion and suggestions upon this subject will a good deal depend upon his knowledge of the matter in these three parts:—

(1.) The number and kind of recruits required.
(2.) The number and kind of boys that can be trained.
(3.) The comparative cost, and value of trained lads.

An observant military Officer can know one part, and a practical educationist can understand the two other parts of the subject; but as no one man can devote his chief attention to both these lines of observation, we may regard with indulgence the present endeavour to look on all sides of the question by one who is deeply interested in the Army, and who has had for many years exceptional opportunities for knowing the wants and ways of boys, and how to deal with them.

Last year, to sustain an Army of 200,000 men (half of them at home), we obtained 20,000 recruits, but under the operation of the short service system double this number of recruits will soon be required every year.

As to the kind of recruits obtained, it will be admitted that in *physique* and character too many of them are not good, and too few are suitable for promotion as non-commissioned Officers.

On this subject we may hear the recent opinion of a high responsible authority. In his speech, not a month ago, Mr. Gathorne Hardy said in the House of Commons:—

" It has been generally supposed, and indeed there is no doubt, that " there is a general disinclination on the part of a better class to enter " the ranks of the Army.

" I should be extremely glad if recruits would come forward of a " higher class than the majority of those I saw; but when I am asked " to take none but men of 20, I say, is it possible to procure men of " 20 while labour in this country is in its present state? A labouring " man of 20 has settled down to a particular work."—*Times, March* 9.

And on this subject, Major Campbell, Governor of the Military Prison at Cork, says:—"I remark that nearly all the tradesmen who " have been admitted during the year have been convicted of desertion; " a good tradesman finds it difficult to resist deserting when wages are " so high."—*Report on Military Prisons.*

Such is the present state of the demand for recruits, and the supply; and it is not caused by want of public interest in the Army, or lack of strenuous efforts in the Recruiting Department, or neglect of important improvements in the soldier's life, as to his barracks, food, and clothing, education, recreation, and pay, his library, savings bank, canteen, and gymnasium.

It will be acknowledged, then, that we want many more recruits and those of a better class; that we must enlarge enlistment and decrease desertion and wasteful discharge.

Three modes of supplying these wants have been suggested:—

1. *Compulsory service* or a general conscription like that made in France a few weeks ago.

However desirable and sufficient this might be, it is not at present probable; and, at any rate, it is beyond the consideration of this paper.

2. Another suggestion for removing our difficulties is to improve and extend the mode of recruiting, and doubtless much can be done by this.

War is a business, and it is the only great business where we go into the market so late to get what we want, and where we expect people to come and help by thousands without being invited.

We treat the matter almost as if crowds of suitable men were pressing for admission to the ranks of our Army; whereas, practically, anyone who can scrape through the very moderate physical examination, be he a dunce, or a rogue, or a run-a-way, expects to be thankfully accepted, and is seldom disappointed.

Of the 40,000 clergy and ministers, the 100,000 teachers of the young, the 150,000 volunteers and thousands of other civilians whose words have weight with the very youths we want, how many are ever pointedly asked to help in recruiting? How little we use for this purpose the pulpit, the platform, or the press, or the other popular channels for information!

The day is happily gone by for getting soldiers with a glass of gin; but, while this bad way is abandoned, many good ways are untried. The recruiting-sergeant is well enough for the lad who is three-fourths decided to join; yet after all, it is the civilian friends of the Army who can best explain its advantages to their own companions, and not the slightest encouragement, that I have ever heard of, is given for aid of this sort.

Sergeants in gay colours may preach up the Army to get recruits, but the preachers who tell most of all on those outside are the men who *have been* soldiers, and who have left the Army and are now civilians again.

If these men are contented in their retirement, their lives, their looks, and their words will persuade others to enlist; but if they are discontented or in disgrace, they will, and they do, deter thousands.

Every man of the 6,000 who deserted, and of the 2,000 discharged in disgrace in the year, feels bound to run down the military system; for, of course, he thinks, or at any rate he says, that it is the Army and not he that is in the wrong.

Every deserter not punished (and that is two out of three), shows that desertion is easy, and every deserter punished, costs much by his loss and his punishment, but more by deterring new comers.

3. A third mode suggested for securing good recruits is to increase the inducements by pay. Putting it shortly, men can be had to do anything for pay, and good pay will get good recruits.

Thoroughly believing this, and that the soldier's pay and pension should be increased and must be increased, still there is the question "when, where, and how, and for whom, ought to be the outlay so as to secure the best return?"

Shall we spend more in soliciting, persuading, not to say inveigling the tired, restless lad whose character has gone and whose work has failed, whose relations are disgusted, and who is himself demoralised? Shall we spend more in feeding him up and drilling and doctoring him, and catching him as a deserter, and punishing him as a convict, and then turn him out to justify his misdeeds, and to decry the Army with all his might for years?

Or shall we not rather try what may be secured by paying something at an earlier stage of this youth's life, by selecting him as a willing boy, educated morally, mentally, and physically, by spending our money in preparing, and not in purchasing and punishing him?

Let us buy the young sapling and not the twisted tree.

Of course there is nothing new in the proposal to train boys for soldiers.[1] It has been often urged and discussed, but it ought to be considered again, and all other plans, too, must be considered anew; because, in one way or another, our recruits must be doubled in number and improved in kind.

If lads are to be trained for soldiers, there are six important sources of supply which are almost unused:—

1. Reformatories.
2. Industrial schools.
3. Workhouse union schools.
4. Voluntary refuges for boys.
5. Elementary schools.
6. Other boys in ordinary life.

Let us see how many inmates in these are available for making soldiers after a period of training; how many at present do enlist from these sources; and how we may obtain from them a large and regular supply.

1. In January last year there were, under the detention of Reformatory schools in England and Scotland, 5,500 boys, of whom half had been admitted at the average age of 15 years, and most of them on a first conviction, so that after two years as inmates,[2] and a year's training outside, 500 could be soldiers so far as age is concerned.

2. At the same time there were 9,000 boys in Industrial schools, of whom 2,000 were of the average age of 15 years; and of these 500 could be soldiers after a year's residence and two years of training.

3. There are now in the Poor Law Union Schools of England 18,000 boys, of whom 6,000 may be estimated as available for military life, and 500 could become soldiers after three years training.

Besides these, there are 50,000 boys relieved by the poor-rates, of whom at least 500 could become soldiers after three years training.

[1] Recent pamphlets on this subject have been published by Colonel Alcock, Mr. J. O. Chadwick, Mr. R. J. Hamilton, and others.

[2] The term of detention may be lessened on recommendation in any case for good conduct, and fitness, and readiness to enlist or enter any respectable career.

4. There are, in London alone, Voluntary Refuges for boys, containing 2,000, of various ages, who are maintained and educated by voluntary subscriptions. I believe that 500 of the boys from such institutions in Britain could become soldiers after a year's residence and two years training.

5. There are many thousand boys in elementary day schools, helped by Government aid and by public rates. They are drilled and instructed, but no special means are taken to show them that the Army is a noble profession. I believe that, at least, 1,500 of these could be soldiers after two years training.

6. Outside all these, there are the countless boys in ordinary life, of whom thousands could be induced to enlist, and at least 1,000 could become soldiers after two years training.

From these six sources, then, I estimate that certainly 5,000 lads could be obtained every year, fit and willing to be trained and to enlist.

Now, here we must inquire—

(1.) How many of these eligible lads do enlist at present?

(2.) What are the reasons why more of them do not enlist?

(1.) In reply to the first question, as to how many do enlist, we find that—

From the Reformatories, in the last twenty years, 16,000 lads were discharged, but only 419 left for enlistment, or 1 in 40.

From the Industrial schools, in the last ten years, 17,000 boys were discharged, of whom 176 left for enlistment, or about 1 in 100.

From the Workhouse schools as a whole, I have no records on this point, but any one who saw 4,000 Workhouse boys march past the Prince of Wales, in 1878, would wish that every one of them could be trained to defend England.

It appeared very desirable to obtain recent and reliable information upon the two questions mentioned above, with respect at least to the three classes of institutions which are supported by public money, and I therefore addressed a circular to about 100 Reformatories, Industrial schools, and large Union schools. In reply to this, I have received authoritative detailed information from 24 Reformatories, 44 Industrial schools, and 9 large Union schools.

Last month there were, in these 77 schools, 10,088 boys, of whom 7,567 were regularly drilled. The total number of at least 15 years old, who had left the schools in the last 5 years, was 7,110, and of these only 641 were known to have become band boys and 332 to have enlisted as soldiers.

As a whole, then, one out of every seven discharged from these selected and best schools went into the Army, but not one in twenty as soldiers.

Analysing the details we find that, even of this small number who go to the Army, a large proportion come from a few schools, showing clearly that, where certain plots of the field are worked, as the whole ought to be, the yield is considerable.

Thus, of the 641 who became band boys in 5 years (out of 7,000 who left), 280 were from two Union schools with 800 children inmates, and 221 were from Feltham Industrial School, with 680 inmates, so

that 500 band boys came from three schools, holding 1,500 inmates, while from all the other schools, holding 8,500 inmates, only 140 band boys came in five years.

Similarly as to soldiers. Of the 332 who enlisted in five years, two-thirds came from Reformatories[1] with 3,000 inmates, or 1 in 75; but from the Industrial schools, holding 4,300, only 100 enlisted, or 1 in 200 inmates; while, from the Workhouse schools, with 2,500 inmates, only 5 soldiers came, or 1 soldier a-year.

It is evident then, that, while the supply of soldiers from some Reformatories, Industrial schools, and Workhouses shows that these sources are available, the total number obtained from them is lamentably, if not ludicrously small, and let us, therefore, hear what are the reasons assigned by the managers for this.

(2.) In reply to my second question, "What are the reasons why more do not enlist?" the following answers are given by the Superintendents or other responsible authorities:—

(*a.*) In four institutions the managers objected to send the lads into the Army.

(*b.*) In five, they say no desire exists for military life.

(*c.*) In nine, the height and size of lads required caused the difficulty.

(*d.*) Ten say that the parents of their inmates object to the Army as a career.

(*e.*) In twelve institutions their lads could not enlist, because boys, however good, are refused if they come strait from a Reformatory, although many of these same lads are readily enlisted after a week or two spent in the wretched life outside.

(*f.*) The managers of 21 institutions say that they have lads able and willing to enlist, but they are below the age required. One says that his institution has sent 4,000 lads into life, and 1,000 within the last five years, and that many of them very much desire to become soldiers, but they are refused.

In addition to this testimony, I may add, from my own personal experience in working the *Central Shoeblack Society*[2] of London, during twenty-four years, and which has sent 4,000 lads into life, that many clever, sensible, well-built lads wished to enlist, but were too young to be received; one of these was ready to spend £60, of his own savings, to fit him for a soldier, but there was no school to go to for the two years required.

Now, all these objections are removable, by the plan to be proposed, except the obstacle from the regulation carried out, in some places, by the military authorities, not to enlist a lad from a Reformatory, be he ever so good.

But what comes of this foolish rule? One Reformatory says, "many "would go into the Army, and the greater part would be excellent "soldiers." Another says that, even with this restriction, 10 out of 81 boys they got out did enlist. Another tells how their boys travelled

[1] 67 of these came from three Reformatories in Ireland, 23 from one in Surrey, 12 from Leeds, and 10 each from Hants and York.

[2] This is the oldest of six Shoeblack Societies in London, which, with 400 boys, earn £12,000 per annum.

60 miles to be enlisted, but were refused, and yet got in at last elsewhere, and are doing well, as soldiers.

In fact, this absurd rule keeps out only the lads who are honest, and who truthfully tell where they came from; but it lets in the worst Reformatory lads, who conceal their past life, or who lapse into idleness and crime, and are welcomed then as soldiers. At any rate, it ends in this, that more Reformatory lads do enlist than boys from industrial schools, in the proportion of three to one.

A restriction which is thus unreasonable and nugatory cannot, of course, be maintained.

As to the supply to be expected from lads in Voluntary Refuges, and from those outside, it is to be remembered that relations, friends, patrons, and benevolent persons unconnected with the particular cases, do at present pay to support and train lads in ships, refuges, and homes, £12, £15, and even £20 a-year; and, after my personal knowledge of the cases of 6,000 poor boys disposed of in various ways, I know that £10 per annum for two years would be easily obtained for such paid cases to make the boys into soldiers.

On this subject a Recruiting Officer states that in his District he could at once obtain 500 unobjectionable boys, but does not know where to get five unobjectionable men.

Having briefly considered the want of recruits, the sources and modes of supply at present used, and the additional source from whence more recruits could be obtained by proper means, I will now sketch the plan for training lads who are willing, but are not yet fit, to be soldiers.

The experiment can be tried on a small scale, so that, at the worst, it would be a small failure, but it might be a great success. It would not at all interfere with the discipline or plans of the Army, but would stand or fall alone. It would not be a substitute for other modes of recruiting, but a clear addition to them. Suppose, however, that it becomes a great success and produces 5,000 good recruits yearly; some may say that is only one-eighth of the 40,000 men we shall need. True, but do we not open up a new and vast source of larger supply? Meanwhile even little helps to a great need must not be despised.

Establish, then, as an experiment, an institution to maintain, instruct, and train for the Army, lads from 15 to 17 years old when they enter, selected as fit and willing to become soldiers; none should leave until 18 years old.

The name of the institution should not include the word "school;" for lads at that age are tired of that word, but the title might be—

The Youths Brigade or Battalion.

The Boys Regiment or Company.

The Recruit Corps or Depôt.

The Barrack should be near one of the Brigade Depôts.

The corps should consist of 500 lads from Reformatories, Industrial schools, Union schools, Voluntary institutions, and outsiders, say 100 from each. All of these should be enlisted before joining.

The "Time Table" might prescribe—

Two or three hours for education, religious and secular.
Two or three hours for drill and gymnastics.
Four hours industrial work, indoors and out.
Six hours meals, and recreation.
Eight hours sleep.

The industrial work should comprise all the clothing, cooking, and baking for the corps; and the artisan work of saddlery, harness, and leather accoutrements for the Army; also land culture, to accustom to spade and pick, and other work in special trades. The depôt might well become a staff-store department of all kinds of work.

Pocket-money should be given in proportion to industrial earnings, and prizes for shooting and progress and good conduct. Music and drawing and the other accessories of education should be supplied, and full dress and undress uniform should be worn.

Of course a high moral tone should be infused into every part of the institution; and, as the mainspring of this, a frank and hearty religious spirit. Not to speak of ancient Jewish warriors and Christian soldiers now-a-days in England and America, let us remember that even in heathen lands the hardiest Army that conquered the world had, among its Captains, the "devout man" Cornelius, who "feared God," and another Centurion who acknowledged the "Righteous" one upon the Cross; and another who had greater faith than was found in Israel, and yet another Roman Captain who helped because he was "willing to save" Paul "the prisoner."

A general sketch of what has been now described was sent to the various institutions already mentioned, and the opinions of their managers were invited.

In reply, some few objected to minor details, and four out of the eighty doubted whether it was feasible and desirable, while twenty gave no definite opinion. Approval of the plan came from more than half of the institutions, including the largest and the best; and some expressed their encouragement in earnest terms as follows:—

"Fully one half of our boys (350) would become soldiers if they found it possible to enlist." The proposed Youths Brigade, others say, would be "a great blessing," "a capital thing," "a most admirable "bridge." One school in Jersey highly approves "for the sake of the "boys, the Army, and the nation." Another says it is "an excellent "plan for supplying a long-felt want;" another, that "more boys are "asked for by Commanding Officers than he can supply;" and another that "all his eldest boys would make capital soldiers, and those growing "up the same." While a few of the managers doubt whether any voluntary cases would be sent and paid for at £10 per annum, others declare that such cases would be numerous; and my own opinion is, that their number would be sure to warrant that part of the experiment.

We may therefore count upon hearty co-operation from a large number of institutions, but even without any such encouragement, most people will allow that the experiment should be tried if the expense of obtaining a good recruit by means of it compares favourably with the expense of securing an ordinary recruit.

Now, it is obvious that the selected recruit, educated, drilled, dis-

ciplined, and trained, cannot, with fairness, be compared with the ordinary raw recruit as he joins his regiment; for this lad will require at least six months of barrack life before he is equal to the trained man, even for ordinary military purposes.

Let us, therefore, compare the expense of a recruit of each kind up to the time when they are more equal in usefulness, that is to say, the total money expended on the trained recruit as against the total expended on the ordinary recruit of six months' service.

Now the form in which military accounts are published makes it difficult to ascertain the cost of an ordinary recruit, but perhaps the following will suffice:—

There is the expense of the recruiting staff, "levy money, &c.," £35,000 for 20,000 recruits, or £1 15*s*. for each; then there is his pay for six months, at 1*s*. a-day, that will be £9 2*s*.; and then his barrack, keep, education, and drill, say at 3*s*. per week, would be £3 18*s*., or a total of £14 15*s*. for the expense of the recruit at the end of six months' service.

Logically we ought, perhaps, to add at least a large share of the money absolutely lost by the 300 desertions of soldiers under six months' service, the money lost by the 1,000 discharges for bad characters, and by the loss of 2,500 deserters at all stages in the half year; also the money expended in punishing the 900 deserters caught in that time, and imprisoned on the average for four months, at £30 per annum each.[1] But it is better to forego the addition of these items in actual money, provided we clearly understamd that a selected, willing, trained recruit will certainly cost much less in these ways than the other man.

In estimating the cost of our trained recruit, we presume that he enters the depôt at the average age of 16, and remains two years before joining a regiment. After a year and a half of training he will be 17½ years old, and, if otherwise suitable, he might have been allowed to join a regiment under the Army regulation as a "very "eligible lad not under 17 years of age," but, nevertheless, let him be kept on still another half-year, to fill up his frame, to complete his education, and to fill up his time to 18 years.

For such a lad, the general style and scale of premises, maintenance, and management, need not be more expensive than those in the five larger of the forty industrial schools with which my official duties make me particularly acquainted; and, giving a margin even beyond this expense, I estimate that £25 a-year will pay for all that is required.

Now the lad we have in hand has been selected for good character and *physique*, and industrial capability. He has passed the time when beginners spoil tools and waste material, so that I would estimate the clear profits from (*a*) his industrial work at 5*s*. per week, or £13 per annum. Next we must recollect that each of the 300 lads at our depôt from Reformatories, Industrial schools, and Union schools, will have £3 paid for his outfit by the usual grants from the Treasury and rates,

[1] Lieutenant-General Sir Lintorn Simmons said (April 9, 1875):—

"The men who disappeared in 1873 cost the country in actual money £596,563, "exclusive of depôt charges."

which for (*b*) each of the 500 makes the sum of 18*s*. per annum. (*c*) Again, the sum of £10 paid yearly for each of 100 lads, as described, will give for each of the 500 the sum of £2 per annum.

Therefore, deducting from the two years' expense of £50, (*a*) the sum of £26 for profits, (*b*) £1 16*s*. for outfits, and (*c*) £4 for payments, we find that our trained recruit costs £7 9*s*. more than the ordinary recruit at the end of six months; and if we add £2 11*s*. for pocket money (at 6*d*. a week), the total extra expense is £10.

I am fully aware that, although our trained soldier may be well asserted to be worth at least £10 more than the average recruit after six months service, even this additional outlay on the trained man must be fully justified on other grounds, else the military authorities would not dare to ask for that sum, nor the Secretary for War venture to propose the vote.

But we have in this case, happily, the full justification of precedent; for in other departments of State, when good men are wanted, much larger sums are given for trained lads.

For a long time the Royal Navy tried to get able seamen from the sailors market, but they are wise enough now to train up boys, and this has been found so successful, that 6,000 boys are training for sailors. They are entered at from 15½ to 16 years of age, and are usually transferred as first-class boys to a sea-going ship, and at 18 years old they rate as able seamen. The cost of each boy's training for the Navy is £60, which is willingly paid by the nation because the boys thus trained become splendid seamen.

For a long time, also, the Merchant Navy (after ceasing to train boys) tried to get men for sailors, but now they too are wise enough to ask for trained boys; and in the *Merchant Shipping Bill*, to be discussed in a few days, it is proposed to give for each suitable boy trained for two years, who becomes a seaman, £30; and this, be it remembered, from a special Shipowners' fund, and not from the public purse; while the Admiralty have promised to grant the use of Training-ships, which are, in fact, premises without rent.

And now, in conclusion, the question asked by me in the "Times" newspaper remains to be answered.

"Why not train some boys for soldiers while other boys are trained for sea?"

When £60 is given to train a boy for the Navy, and £30 is given to train a boy for a merchant seaman, will it be too much to give £10, or even £20, to train a lad for the Army?

If, indeed, this outlay shall, after fair trial, be proved to be too much for the positive benefit obtained, then my project falls to the ground; and while I shall thank those friends who have considered it, I will humbly apologise to those who have lost their time in the matter. But if, by the means proposed, even 1,000 good soldiers can be added to the Queen's Army, it will be gratifying to us all, and not least to one whose boyhood was passed in barracks, and whose venerable father (having himself received his commission when yet a boy) left in the regiment which he last commanded a little lad, the only person still in the same corps, the present Lieutenant-Colonel of the 93rd Highlanders.

Mr. CARLTON TUFNELL: I have taken considerable interest in the subject that has been brought before us, having been for several years the official inspector of the greater proportion of the schools mentioned by Mr. Macgregor, in his lecture. I think that he has pointed out the proper mode of meeting the difficulty, now very strongly felt in this country, of procuring recruits for the Army. The schools of the Local Government Board are filled by sixty per cent. of orphans, and it has been absolutely necessary to bring them up to some trade. Many years ago, I was obliged to pay particular attention to the sort of trade we could bring them up to, and how we could so train them as to enable them to obtain an honest independence in after life. I soon found that there was a great demand for boys in the Army, of a certain description, and the War Office told me, if I would only take care that the boys were properly instructed in music, a great number could be taken into the Army. I was also told that, if I put these boys to drumming, they would take a number of them as drummers, for it was only by early training that they could acquire the elasticity of wrist requisite for that occupation. I was told afterwards that there was a great want of tailors in the Army, and they said to me at the War Office,—"Cannot you put the boys to tailoring? for, if they can "do that work, we shall be happy to take a great many of them into the Army." Well, all this was done. I persuaded the Government to appoint band-masters and drill-masters to these schools—tailors were always employed before—in short, I wished to make the schools as military as I possibly could. The effect of this was seen in the drill reviews that have taken place, for three successive years, in this country. The first took place in the year 1869, at the Crystal Palace, when Sir John Burgoyne wrote a letter, afterwards published in the newspapers, giving the very highest credit to the schools for the way in which the boys did their drill. There have been two other reviews since, in Hyde Park and in the Horticultural Gardens, and I believe every military man who saw what was done by the schools must have regretted that the children were destined for any other profession than that of the Army. Mr. Macgregor has mentioned the number that have gone from these schools, and, according to the tables I have, I think he has somewhat underrated that number. We find, from the sixteen Metropolitan Poor Law Schools alone, in 1870, there went 240 musicians to the Army, 119 to the Navy, and 7 as tailors. In the next year, 236 went into the Army. Those numbers do not quite coincide with the numbers given by Mr. Macgregor, who, I believe, has not included all the London Poor Law Schools in his calculation. I find, from the reports of the Inspector-General on recruiting, that the boys who have gone from those schools into the Army have given the highest satisfaction to their Commanding Officers. They have generally gone as musicians, but being so well instructed in intellectual matters—in reading, writing, and arithmetic—many of them have been lost as musicians, and have become non-commissioned officers. Of course, we have experienced difficulties in carrying out this matter. These boys are mostly London boys, and are extremely well fitted for the service in most particulars, except one; they are very clever, apt, ready to learn, very good humoured and courageous, and, if they are musicians, they generally play their instruments exceedingly well; but they are all deficient in stature, and that is the difficulty we cannot get over with London boys and boys from large towns. If we could get country boys, we should have much less difficulty in supplying the wants of the Army, for their physique would be very much superior. London boys, unfortunately, are so stunted in growth that they very often give dissatisfaction when first enlisted in a regiment, but after a time, however, when the Officers find how intelligent and obedient they are, and that they know their drill, they are perfectly well satisfied with them, and I thing they like them better than any other recruits, because their intellectual education is extremely good, it being compulsory in the schools where they have been trained, and hence, besides the advantage of knowing their drill, they have been far better taught than in ordinary village schools. Then, there is another difficulty I have met with. Everyone knows that, amongst many of the lower classes in this country, there is a sort of objection to going into the Army, according to a saying which is general amongst them, that "You are going to be shot at for a shilling a day," and it is astonishing what damage that single sentence does. The consequence is, when these boys have relations or parents, they try all in their power to

prevent them going into the Army. Now, the War Office have a very good rule, on the whole—that they will never allow any boy to enter the Army without the consent of his parents. As respects the upper, the middle, and lower classes, it is a very proper rule, and ought to be observed; but, with respect to these lowest classes of all in the Reformatories, or these Poor Law Schools, the rule seems to me cruel and unwise. It often happens that a pauper parent, or even a convict parent, prevents a boy from entering the Army who is well fitted for it. I have a case before me now of a boy who played the cornet perfectly well, and wanted to go into the Army; his father, who was a convict, would not allow him to go, and the Army would not receive him without the convict's consent. That is a rule, I think, that ought not to be followed strictly. A case occurred, only within this last week, where a boy was sent out of one of the largest schools, well instructed as a tailor; he went to the 46th Regiment, and was going on extremely well, being very happy and very comfortable. He had been deserted, and had not seen a parent, friend, or relation for years, but, as it often happens in such cases, when the boy was sent into the world and was gaining an honest living, a woman, a pauper receiving relief, came forward and said she was his mother, and angrily declared to the guardians, "I insist that my boy shall not remain in the Army." The consequence was, the guardians sent word to the Horse Guards, and they, unwisely, I think, sent him back. The boy was a fine looking boy, as well fitted as any boy could be to make a good soldier. He was a very good tailor, and was working with the regiment, giving perfect satisfaction. He came before the board of guardians, in his uniform, and said he did not wish to leave, but his mother insisted that he should go. The boy was perfectly broken-hearted, and his mother being utterly unable to assist him, he is now selling matches in the streets. I think the rule of requiring parental consent should not be observed in such cases. Sometime ago I made an application to the War Office to beg them not to follow this rule in the case of children from these schools. The case was laid before the solicitor, and what he said to me was this—that, if the children had made their engagement with the Crown under the sanction of the Poor Law Authorities or industrial schools, he would neither give them up nor compensate the parents. I think after that, it should not have been done. I think the Office has forgotten this, and the result is, boys are frequently sent back who are perfectly fitted for the Army, because their foolish parents insist that they should not be soldiers. That is a rule which stands very much in the way of the enlistment of this class of boys. If it were not for this rule there would be a great many more boys ready and willing to enlist, and I think if they are willing to enlist, their parents should not be allowed to have any voice in the matter, when the boy has been brought up at the public expense. I do not know whether it would be absolutely necessary to carry out Mr. Macgregor's idea, that we should first found a school for the purpose of training boys for the Army. It has often struck me that there is a school in existence which ought to be appropriated to that purpose—I mean the Duke of York's School—but at present it is a mere charity school. The original intention was, I have no doubt, to benefit the Army, and no fault can be found with its present management as a charity school, but it would be of great use to the Army if it could be transformed into a training school for young recruits, in the way suggested by Mr. Macgregor. They now take children into it as low as seven; there is no examination to see if they are fitted for the Army, and no compulsion to make them go into the Army, the consequence is, the school is of very little use in supplying recruits for the Army. Perhaps that school could be appropriated to the purpose Mr. Macgregor has mentioned. The boys should not be received under a certain age, and then it could be turned into a sort of cadet school for the whole Army. Mr. Macgregor mentioned the age of sixteen, but there is a difficulty in putting it to so late a period of life. Boys in that rank of life get into their permanent occupations much earlier than they used to do, and I would sooner see them received at fifteen instead of sixteen.

Mr. Macgregor: I said from fifteen to seventeen, and that the average was sixteen.

Mr. Tufnell: These are in reformatory schools, and, in the Poor Law Schools, and the boys cost at least £25 a-year to keep; therefore, the persons who maintain the

schools are extremely desirous of getting rid of them as soon as possible. If you do not take them at rather an early age, they will get them out to other occupations, and you will never see them at all.

Lieutenant-General Sir DAVID RUSSELL: If the requisitions of the foolish parents were all to be attended to, it would be necessary to keep an extra staff of clerks to answer the enquiries made.

Major-General Sir CHARLES DAUBENEY: I take it, Sir, that after the boys are enlisted, the parents have nothing further to do in the matter. An enlisted boy is like an enlisted soldier, and unless he himself agrees, or is over-persuaded by his parents, he cannot be discharged from the service, and, even then, there must be a heavy compensation paid by some one before he can get his discharge. I think that the question should be decided by the boys themselves being appealed to, and if they decide to remain in the service, and have been properly enlisted, I do not think that what the parents may have to say upon the subject should be taken into consideration. I quite agree with what has been stated about reformatory and industrial schools. I have been myself for some time, as a magistrate, connected with industrial schools, and have had a good deal to do with them. Looking at them from a professional point of view,—for I must say I went to them with the eyes of an Officer as well as those of a magistrate,—I was very glad to see the educational progress made by the boys, and I also saw a great number of boys of excellent *physique*—boys who might have turned out as good soldiers as any that I ever saw in my life. They were trained and educated for general purposes, as it might be, but at the end of their time they had the option, to a certain degree, of deciding where they would go to. I have heard it said, in fact, I am able to say it as a fact, that some Commanding Officers object to take boys from these industrial schools, because they are afraid that they will contaminate those with whom they are associated. Having had a good deal of experience, I must say I think this a very groundless objection, for where do we get our every-day recruits from? We do not know, when we enlist a recruit to-day, what his antecedents were yesterday; he might have been anything yesterday—the vilest man in the kingdom—and yet, if he is physically fit for the service, he must be taken. Well, you have the guarantee, at all events, of these schools, that the boys who are in them have not been committed for any serious crime. They have been under tuition for three or four years, receiving reformatory training, and, if that is worth anything, it must, as a matter of course, have produced its effect in making them better subjects, according to the length of the training and the mental capabilities of each boy. At all events, you do know something of that boy for three or four years previously, and you very often know nothing of the antecedents of the recruit that you enlisted yesterday. Therefore, to say that because a boy has been in an industrial school or a reformatory, or anything of that sort, he is not eligible to be put into the Army is, I think, a very strained objection. Besides, it is well known that the authorities of those schools take very good care not to send you an unreformed boy, because such boys are all put into a separate class, by themselves. They would only send you boys who would give a good promise of making good subjects as soldiers hereafter. I think Mr. Macgregor mentioned that one way of increasing the recruiting of the Army was to offer the inducement of increased pay. There may be, perhaps, some Officers here who have commanded regiments, and who will, I think, agree with me that the pay of the soldier, at the present moment, is as high as you can safely make it. I mean the present class of soldier. If you increase his pay, what will he do with it? Unless you can make regulations which will bind him to lay aside a portion of his pay, so that he shall not spend it whilst serving, in order that it may be paid to him, or laid out to his advantage, when he leaves the service, what other good use will he make of it? The men you are getting now, come from that class of society that does not know how to make a proper use of their wages. I would almost challenge contradiction, from any Commanding Officer, when I say that it is not advisable to increase the actual money given into the soldier's hands. It may be possible, of course, to increase his comforts, and so render the position of the soldier more attractive; but extra pay, I venture to think, would not conduce to the discipline of the Army. The prejudice against a soldier's life, which has been

stated to exist among parents, is not confined to boys in reformatories. I am sorry to say it is found everywhere else. We constantly hear of parents saying, when a young fellow enlists in the Army, "He is a gone 'coon; he is done for for ever," and they will do everything they possibly can, as a rule, to get him out of the service and back to themselves. The too general opinion is that a man does not better himself by enlisting--that is the feeling of the present day. Then, again, Mr. Macgregor spoke of taking them from the age of fifteen to seventeen. The question is, at what age should recruits be taken? I do not approve of the present mode of enlistment, in which a fellow can say he is eighteen, when he is not sixteen, which we know occurs every day. Probably, the medical department would be the most competent judges whether a man was efficient or not; but, looking at the question of expense, of course I suppose you calculate upon enlisting a very much larger number of boys than are at present enlisted. At present there are only fourteen allowed in each regiment; but, by your system, there would be a much larger number of boys enlist from fifteen to seventeen. At what period is it expected that they will become efficient soldiers?

Mr. Macgregor: At eighteen.

Sir Charles Daubeney: I mean capable of carrying rifle, knapsack, and everything belonging to them. I know very well in foreign armies they do not enlist under twenty, but I am sorry to say we get too many young soldiers in our Army at present; at the same time you must take into your consideration that for a certain number of years, *i.e.*, until they attain the age of nineteen at all events, the public will have to pay for boys who are practically inefficient solders, and it is a question how far that could be allowed to enter into the calculations of the War Department, who would certainly object to pay for so many under-aged lads. The rule is to allow a certain number of boys in every regiment; if you put in too many of them, then the public are paying for so many boys under age, who cannot be called efficient soldiers. I merely mention this as a matter for consideration. I do not think that the deficiency of stature which you have mentioned is of so much consequence. In the regimental schools we train the boys of the regiment, sons of soldiers, and I am bound to say as a rule,—and I think every officer here will corroborate me,—that the sons of soldiers in the Army are generally a very stunted race; how it happens to be so I do not know, but they are generally shorter than others; and, of course, we must take into consideration also their appearance in the ranks. I do not think they are less efficient soldiers, provided they have the requisite physical strength, and I do not attach so much importance myself to the question of height or stunted appearance as some people do. Of course it is advisable to have men of a certain stature, and I presume that all the boys would not be of the stunted stature mentioned; and I think a great many of them would turn out very good soldiers. At all events, with regard to my experience at the Reformatory at Feltham, I must say I saw there as fine a set of boys as I ever could wish to see. I have often expressed a desire that the Commanding Officers of regiments would take the trouble themselves to pay a visit to these places, to see the way in which the boys are trained, and observe the moral culture which they receive; and if they did not find that those boys are actually more fitted, in a moral point of view, to enter the Army than the recruits picked up in the streets every day of our lives, I shall be very much surprised to hear it.

The Reverend Sydney Turner: I came here to be a hearer rather than a speaker, but some things stated induce me to offer a few remarks on the subject which Mr. Macgregor has so ably handled. I suppose there is no question as to the expediency of what Mr. Macgregor proposes. Everybody must feel anxiety at the great deficiency of the military force of the country, and the difficulty there seems to be in recruiting it, and everybody must be anxious for any plan which will give us a greater number of soldiers and more efficient ones. For myself, although a clergyman, having the highest possible respect and admiration for the Army, and thinking that a soldier's duty thoroughly performed, entitles him to the respect and trust of all his countrymen, I should be very glad to see their number very largely multiplied. Speaking from my particular sphere of experience in Reformatory and Industrial schools, I may state that a considerable number have passed from a few particular schools into the Army, but still they are but a small portion of those

who might have done so. Nearly 28,000 boys have left reformatory and industrial schools since I undertook their superintendence in the year 1857, of whom more than half have been young lads that have left at the age of from seventeen to twenty. But while nearly 4,000, or 14 per cent. of these have gone to sea, only 681, that is, about 2½ per cent. have gone into the Army; and yet I am quite sure I could verify what has just been said, that scores and hundreds of them had everything in their *physique* and good habits to warrant the belief that they would make good soldiers. And more than that, they had just that impatience and restlessness of character, and that wish for excitement and action which require the guidance and restraints of discipline; they were just the persons who would do well in the Army, and probably would not do so well in trades or other occupations where they would be left to their own wills, and be without a controlling influence exercised upon them. Hundreds of these lads, too, have been Irish lads, who, it might be supposed, would be more easily induced to adopt a military life than any other. Yet, as I have said before, hardly two and a half per cent. of these lads enter the Army. I ask myself, why? and I think there are two or three reasons which partially, at least, explain the question. In the first place, they do not like constraint; they have had a full share of constraint while in the school, and they know enough of the regiment to be sure that they will have to submit to a still greater degree of it if they enlist, and they prefer their own independent action to obedience to the will of others. The next thing is, they commonly hear from their friends that a soldier's life is, after all, but a poor trade as regards making money, and the liberty of spending it. They may know, indeed, that they will be fairly fed and housed, and have a great many comforts provided for them, but these are such as perhaps many of them do not value, and they know, as far as the question of getting or saving money is concerned, the soldier has about the poorest chance of all, and so as to promotion and getting on in life. They know that if they become sailors, and behave well, they will be promoted gradually to first class men, and may attain, as scores of them have done, to the position of mates and assistant officers; they have had a very fair education, and are very often intelligent, and if they have but character and steadiness they can reckon on getting on. They know perfectly well if they work hard at a trade, or go abroad as emigrants, they can do very well; they can manage to get from twenty shillings to twenty-five shillings a-week, and in many lines of life still more. They do not think, therefore, that the soldier's trade is worth having in its money value. There is now, too, the question "What will it lead to?" If I become a soldier for five or six years, I shall unlearn a great deal of the industrial knowledge which I have learned. I shall lose much of the skill I have gained; I shall get out of regular working habits; I shall have to pass the great part of my day in doing very little in the way of active continuous labour, and at the end of my six years' service, when I shall have the option of being discharged I shall probably be pretty well sick of it, and while I shall be half spoiled for many of the other avocations of life by the particular training I have gone through, I shall not probably be so captivated with what I have gone through as to stick to the Army, and make it my permanent profession. Then there is another drawback—there is so little to excite them in the business of a military life. There is very little chance of actual employment in war. There are but few chances of promotion or distinction; the greater part of the soldier's life is spent in ordinary routine, and there is little to arouse his interest or to stimulate his ambition. Now a lad going out to sea has always something or other to keep up his interest, and a man in a common department of life has always more or less of an object before him, something which he can gain to make his position better. It is hardly so with the private soldier. I do not wonder, therefore, that the youths who are trained in reformatory and industrial schools are generally so little disposed to enter the Army. I doubt whether a school established specially for the purpose of military training would answer so well as Mr. Macgregor might be inclined to expect. If the boys are to be sent to it under any kind of compulsion or constraint they will look upon it as a means of additional detention or imprisonment, while if they are left to their own inclinations, and are invited to volunteer for it, I think that for the reasons already stated very few will be disposed to enter. But I think that there might be more inducement given to pauper as well as to

industrial and reformatory schools to train their lads as soldiers; to infuse a more military spirit into them, giving them not mere dry details of drill, for the purpose of enforcing obedience, and making them more exact and punctual, but training them to a discipline of order, alertness, activity, and endurance, with something of an intelligent idea of its use and value. I cannot help thinking that the schools might well be more encouraged to do this, and to aim at leading and training their lads to military service, and stimulating them by prizes and distinctions to enter it. It is proposed to give special aid and encouragement for training boys for the mercantile marine through the Board of Trade, and for the Navy through the Admiralty; and it seems to me that it would be equally worth while for the War Office to give premiums and encouragements to the large schools which are supported by charity, or by the public rates and taxes, and which contain boys capable of being brought up in the Army, to induce them to exert and interest themselves more in promoting the boys' enlistment, and in leading the boys to take a fancy for a military life. I see Captain Brookes present, who has this great institution at Feltham under his superintendence, and probably there is no institution that has been superintended with more ability and earnestness, or with more credit to its superintendent. Feltham has a very much larger number of elder boys than most other industrial schools have, and as Sir Charles Daubeny has said, a very considerable proportion of these lads are such as one would like to see going into the Army. Very few of them, however, do so, except a few who are trained as musicians, and enter regimental bands. I should be very glad to hear from him, whether he thinks that these lads could be induced to enter military service under present circumstances, robbed as it is now of so much of its old romance, and invested as it is with a great many rather discouraging prospects in a commercial point of view if more encouragement were held out to them, and the school training were more specially adapted to interest them in the soldier's profession, and prepare them to succeed in it. As to the weight to be allowed to the objections made by parents to the enlistment of their children from the schools, we must after all put ourselves in other people's places. Although we might have misconducted ourselves, we should not quite like our children to be taken from us against our will and made soldiers, sailors, or what not. I think every parent has a right to object, and make reasonable objections. It is but fair, for the sake of the boy himself, to give to some central authority the power of judging of these objections, and, under certain circumstances overruling them; but it would scarcely be right to sanction the enlistment of a boy for the Army, or the putting him into the Navy, or the sending him out as an emigrant directly in the teeth of his parents' wishes, except in two cases; the first, when he is above sixteen, and can therefore act for himself, and has a right to judge for himself; and secondly, when his parents are of that thoroughly profligate kind, and have so utterly neglected him that they have lost all right to control. Under those circumstances society has a right to say, "The parental bond is fairly snapped, and we, as guardians, have a right to supersede the parents altogether," and to consult only the advantage of the boy and the welfare of the community.

Captain Brookes: I am more accustomed to act than to speak, and came here to-night without any intention of making remarks. My feelings are of a mixed kind with reference to this matter, for I have my doubts and I have my hopes about it. My doubts are, as Mr. Turner has said, that I think boys would kick a little against going into a second school after leaving a first. It appears to me possible that Mr. Macgregor's plan could be modified by establishing smaller schools under the new system of brigade depôts, so that each depôt might be allowed to have a small number of boys about 16 years of age attached to it, who might eventually become soldiers, and who, if they did not come up to the requirements of the Commanding Officer could be dismissed. Perhaps some tentative measure of this sort could be carried out. At Feltham, where I have had the honour of being in charge for some years, I have endeavoured to introduce a kind of *quasi* military system and spirit; and, having belonged to a service which is said to be neither fish, flesh, nor good red herring (the marine artillery), I have consequently had some experience of military and naval life. I prevailed on the magistrates (who are the Committee of visitors) to start a land ship from which we send 70 or 80 boys annually into the mercantile marine, and also to organise two bands, by means of

of which we place about 40 boys yearly in the Army. I must speak most thankfully of the Horse Guard authorities, who have always been most kind and obliging and anxious to promote the enlistment of boys. The late Inspector-General of recruiting, General Edwards, very kindly came down and saw the school himself, expressing his entire approval of everything. He also authorised me to forward lists of the boys ready to be engaged; but I have not found it necessary to do this latterly, because the demand for boys has been larger than we could supply. Here and there a boy turns out indifferently, but the great mass turn out well. There are several General Officers who take a special interest in the training of the boys connected with our school. The lads take very readily and willingly to drill; and, although I do not like to say too much of ourselves, I am sure any military gentleman, who has seen our little battalion march past, must acknowledge that they do their work well. We have had such men as Colonel Battersby of the Military Asylum present, who was kind enough to say he thought our drill was quite as good as his own; and I could not expect him to say more than that. I think if some sort of system could be adopted by means of which a certain number of boys could be received at the brigade depôts, who were calculated to make good soldiers, and who could receive a certain amount of industrial training in tailoring, shoemaking, saddlery, &c.; then these boys after a year or two of training could be made very valuable adjuncts as pioneers, &c., when they were drafted to a battalion. I regret to say, however, I have not given the subject the consideration it requires. Mr. Turner alludes to the point of parents refusing consent to the enlistment of their sons. It is certainly very annoying when you see a smart young fellow who himself says he would like to enlist, but, because his father will not sign the paper which is necessary to carry out this desire, he cannot do so, because he is under 16. Indeed, it so happens that the age fixed is extremely awkward, as the age for the enlistment of boys in the Army is from 14 to 16, and the "age of nurture" (as I think it is called) does not cease until the latter age; consequently, when a boy can act for himself, he is beyond the term for enlisting as a boy, and not old enough or physically fit to enlist as a recruit. If, however, the Army could extend the age to 16½ instead of 16, so that the boys between 16 and 16½ could sign their own contracts, which they would then be legally competent to do, this would remove the difficulty complained of to a great extent; and I would observe that the Navy already take boys up to 16½. I would only say if any gentleman can find time to favour us with a visit at Feltham, we shall be very happy to show them what we are endeavouring to do there.

Mr. WALLACE (in response to the invitation of the Chairman) said:—I do not know on what point I can contribute any information after the paper we have heard read, and the discussion that has taken place. I would only note what Mr. Turner said about reformatory schools. Upon that subject, unfortunately, I have no experience at all. I do not know how it is that so few boys enlist from the reformatory schools, but I do know that a great many boys in industrial schools express a desire to go into the Army, a desire which they are prevented from carrying out by the regulations which prevent boys between 16 and 18 being admitted into the Army. It may perhaps be the hope for the unattainable which makes boys of 16 profess to desire to get into the Army, and to complain against the restrictions which exclude them. I cannot, however, say anything upon that subject, and reformatory schools I am not at all acquainted with.

General Sir WILLIAM CODRINGTON, G.C.B.: This is not merely a question of schools. We might all wish, if possible to get the same kind of schools for the Army that have been so successful for the Navy, but we can understand the different inducements held out. The Navy are better paid, that is one point; they have short voyages, that is another point; and, as one speaker has said, they can get on in their line more rapidly than they can in the Army if they enlist. Of course the question is intimately connected with the general system of recruiting; but where you have a parental system how is it possible that you should enforce upon those who are to be put into these schools, the necessity of entering the Army. You do not do it in any other class of life, and I do not think it could be enforced even with State education in these schools. I think that would be the difficulty, and I do not know whether the Lecturer can show any means of getting rid of it. Then as to the

general system of recruiting, what is there to induce a man to go into the Army? Is it the pay as compared to the pay of civil life? We all know that it is not so. His pay is certainly very inferior; even with all the advantages of lodging, fuel, light, &c., his pay is positively inferior in point of money. Then what do you insist upon for that pay, small comparatively as it is with regard to that in civil life? You take him for ten or twelve years from his country to India. You take him to a barrack where he cannot say his life is his own, or any portion of his time if the the public service requires he should give it up; and, with all this, you are to induce a man to enter the service voluntarily. Again, it may be asked, what is to induce a good man to enter as a soldier? In time of war there may be a certain quantity of excitement, but the facts show that in time of war there is even a greater difficulty in getting recruits than in time of peace. I think that was the case in our last war, and at all events if you do get the numbers, you certainly get into a lower stratum of society to supply the great demand there is in an Army on active service. I should be very glad if Mr. Macgregor will be kind enough to tell us how one is to get over that question of a sort of apprenticeship or enforcement of their going into the Army from these schools. With regard to the small size of the boys mentioned, if that is the fact, surely that is one great drawback to their going into the ranks. I mean if they are so very small. The boys that are spoken of may do for bandsmen; and, if they play well, it does not signify much that they are defective in height; but for the ranks it is a question not only of height but of positive physical strength to march and carry weight. Having regard to this, I think it will be found the very small men—the boys that Mr. Turner was speaking of, of about 5 feet 3 or 4—come below the mark we wish to see in the Army for the necessary purpose of carrying weight and active marching. Although this discussion is rather limited to one point, we, perhaps, naturally get into the general question of recruiting; but with regard to the schools I am afraid it is impracticable to carry out the inducement to enlist, which is either a question of money or the enforcement of it as a matter of compulsory apprenticeship.

Sir Charles Daubeny: The boys I allude to, though short as boys, do lead to good men of 5 feet 6 eventually, and I think 5 feet 6, if they have physical capacity, is not a bad height.

Mr. Tufnell: That is what I meant. I published a list of the heights of all these children, and it is certainly low for 14.

The Chairman: I think what Mr. Tufnell alluded to was the smallness of the boys when they were boys at school. If I recollect right, you said they were 4 feet 2 or 3 at the time. I know there have been objections made when boys have been proposed from some of these schools that they were so exceedingly small and diminutive that they gave no pospect of growing into able-bodied men. But, then, they were only 14 years of age or a few months older. Mr. Tufnell's experience is mine also, but I think that is what Mr. Tufnell meant.

Mr. Macgregor: The number that would be possible to obtain, must be after meeting all the objections. If we had to deal with hundreds only, the objections that have been mentioned would have brought them down to something too minute to consider at all. We are dealing with tens of thousands, with hundreds of thousands, and after taking away all that are physically unfit, and after excluding those whose parents will not consent, we still have thousands of boys who cannot get in; because, at 16, they cannot be enlisted, and if they could get in, we know for certain, a number at 18 would be ready and fit to enlist, and these are asking for admission and cannot obtain it now.

Mr. Tufnell's numbers, with respect to those who enlisted from the metropolitan schools, differed from mine for this reason. I took the numbers only from those schools that wrote to me, and those were outside the metropolitan district as well as at home.

The consent of the parents is, in my scheme, absolutely necessary. At the age of 16 any person, a boy or girl, has power to act without the consent of their parents. I would throw all doubtful cases away; and, though I should be sorry to leave out the boys whose parents would not consent, their objection to consent would probably be removed when they saw other boys coming in and being well treated in our establishment.

As to the age, some little mistake was made about that by some speakers. The proposal in my paper is that boys should be *received* from 15 to 17, but that none should be sent into the Army till they are clearly 18. If it is objected that such lads are too young, then all your present recruits may be too young also, and any person can get in at that age. I propose that only a certain number of selected and willing lads should be taken, and out of the 5,000 that I believe are available yearly, I suggest that 500 might be tried, so that the margin left for unexpected difficulties is very great.

Mr. Turner speaks of the boys not being likely to come from one detention or another. I perfectly understand that. Mr. Wallace, myself, and others, who visit these institutions know a great many will not come at the *end* of their term; and it is for that precise purpose I put the years of admission from 15 to 17, because many of the lads that have been two years in a reformatory would gladly go to an Institution of this kind if a year of the sentence were remittted them. Some would come from outside, some from refuges, and some from reformatories where you can keep them to 20—some from industrial schools where you must discharge them at 16.

With respect to what Captain Brookes said, that such things might be done on a small scale, the trial might be made on a smaller scale still, you might try fifty boys at the brigade depôts. But there are many objections to that. On another point we know that in industrial schools there are cases voluntarily paid for alongside the boys sent by magistrates, and that both classes get on together uncommonly well. In one school in London we have about one-third voluntary cases who go out into life after being trained along with these other little fellows from police courts. I believe it has an excellent influence on both kinds of inmates, and it keeps the Institution from having a "prison feeling" to know that there are many present who can be taken away by their parents or patrons at any time. But as for enforcing enlistment of the lads, if the inducements do not bring them willingly, this project falls to the ground.

I would therefore ask you in some degree to consider the proposal. Though very small it would at any rate do something. It might be a good example, although it could not be expected to be multiplied by ten at once. If out of these 5,000 you could not get 500 boys, first rate in appearance, character, physique and willingness, then of course imagination has led one into a poetic vision which ends in smoke.

The CHAIRMAN: I think, gentlemen, the Lecturer is entitled to our best thanks. This very interesting lecture which Mr. Macgregor has been good enough to give us has led to a still more interesting discussion. A great many points have been raised which I think are well worthy of consideration, and there are one or two small items on which, perhaps, I ought to say a word or two, as I occupy a sort of official position.

Everybody will admit that nothing can be better, if it can be carried out, than to feed our Army with well-trained youngsters. I am quite certain they turn out the best recruits we can possibly get. There is one branch of our service which many present will bear me out in saying has been enabled to carry out the system more thoroughly than any other, and that is the Royal Artillery at Woolwich. They have a large stationary establishment at that station, with numerous facilities and advantages, and the result has been most excellent. Many of those who are best qualified to judge, old Officers of artillery, Staff Officers, and others, have assured me that the greater proportion of their best non-commissioned Officers have been boys very often born, but almost invariably trained in the regiment. At Woolwich they have many facilities for giving boys a good education and teaching them trades, while they are not shunted about as regimental boys in cavalry and infantry regiments would be from one place to another. It may therefore be taken as a model of what we wish to do for the rest of the Army. For my part I should be only too glad if I could see every one of these new brigade depôts turned into a training establishment for boys. I should like to see 100 boys at each of these 70 depôts. But then comes the question of money, which crops up on every occasion; and I think there are some here (Major Wilson amongst others) who could testify how great the expenditure would be if my proposal were carried out—the buildings,

schools, teachers, and other matters would run up the expense to something that no Secretary of State would face. The principle of taking boys is excellent, but, unfortunately, as the regulations now stand, we are completely debarred from carrying it out to the extent we would wish. The regulation is one boy per cent. of the rank and file of the Army. That is but a small proportion; even to a full regiment on foreign service it only gives ten boys. The supply of boys is so large that I venture to say we could get any number we liked—we must pick and choose among our different establishments—and you must recollect that besides the usual applicants we should like to provide for, we have the Royal Military Asylum, the Hibernian School, and the vast number of soldiers' children who really have a claim upon the service before outsiders. I consider that the difficulty is to get vacancies, not boys. We could get a dozen, fifty, a hundred boys for every vacancy we have to put them into, but the question is will the authorities and the Chancellor of the Exchequer stand it? I know on one occasion I happened to be present when the Secretary of State, the Commander-in-Chief and others in high authority were talking over this very subject. They all said—"Yes, we must have more boys;" and the Commander-in-Chief said—"Oh yes, by all means, but they must be supernumerary to the establishment, as for every boy added to our ranks I lose a bayonet." The Secretary of State retorted—"It is a most excellent plan, but I cannot have "them extra to the establishment—we cannot stand it in the Estimates," therefore the question of the boys fell through entirely. I think if we could establish something like what Mr. Macgregor has so ably put before us, we might meet a good many of these difficulties; but then, again, it is a matter of money, because this establishment or school cannot be supported without some Government help. Of course Government will not pay money without some equivalent, that is to say, they won't keep a boy for two or three years without getting any service out of him then or subsequently; therefore the question of enlistment or apprenticeship which I think Mr. Turner alluded to is absolutely necessary. If these boys enter this establishment they must go with the full idea of carrying out their engagement which is to serve Her Majesty. As to the difficulty of getting boys to go there, there is not the least disinclination on the part of boys generally to join the Army. But we must remember in the Army it is a different thing from the Navy. In the Navy there are various employments and avocations in which a boy can be equally well if not better employed than some of the men on board ship, and there they are always under supervision; in fact they can be made useful at a much earlier age than boys for the Army. Besides, every man in the Army is supposed to be fit and able to undergo the fatigues of a campaign; and therefore we could not burden ourselves with a number of boys unless they were kept in a sort of institution such as Mr. Macgregor alludes to until fit for the ranks. There has never been any lack of boys to fill the vacancies occurring in the service; but I am afraid the question of £ *s*. *d*. is one we must get put forward by some one who can persuade those who hold the purse strings to let us have something given towards the necessary expenditure.

I am sure you will all join with me in thanking Mr. Macgregor for his very able paper.

Evening Meeting.

Monday, April 19th, 1875.

COLONEL H. C. FLETCHER, Scots Fusilier Guards, in the Chair.

NAMES OF MEMBERS who joined the Institution between the 5th and 19th April, 1875.

LIFE.

Stanton, F. Robt., Capt. late Royal Scots.
Domville, W. C. H., Lieut. R.N.
Fraser, Thomas, Capt. R.E.
Markham, Edwin, Major R.A.

ANNUAL.

Trevelyan, H., Lieut. 32nd Regiment.
Northey, W. B., Lt.-Col. late Cold. Gds.
Marriott, W. F., C.S.I., Major-General.
Colquhoun, J. A. S., Capt. R.A.
Mansell, A. B., Lieut. R.N.
Robertson, Murray, Capt. West Kent Militia.
Abbott, James, Major-Genl., R.A., C.B.

"THE GATLING GUN; ITS PLACE IN TACTICS."

By Captain E. ROGERS, F.R.G.S., Staff Officer of Pensioners, Chester.

WAR has become so terrible from the increasing powers and accuracy of fire-arms, that a proportionately keener interest is manifested in movements technically termed tactics, which tend to secure a certain degree of safety in the field whilst inflicting the utmost amount of injury on the foe in the shortest possible space of time; for the ancient conditions of fighting are reversed, and instead of movements leading up to some grand and supreme effort whereby the enemy, gradually intimidated, was finally crushed by an overwhelming advance in compact columns, modern tactics seem to court immediate contact in the loosest formations—and the sooner the better.

Now as the Gatling, like all mechanical contrivances, seeks to supersede manual by self-acting labour, or in other words to economise the human life that must be sacrificed at the outset of a battle or campaign carried on by an enterprising General desirous of sudden success, the question of tactics is for it of paramount importance, and demands special consideration, inasmuch as I venture to contend that by a judicious employment of this means to the end, the hitherto awful loss of men in primary actions will be brought within a minimum compass on the side of the combatants availing themselves of such retaliating substitutes. I was present in this theatre two years ago, when Major Henry Brackenbury delivered a most impressive and exhaustive lecture on the "Tactics of the three Arms," and we might naturally have expected then to hear something reliable as to the action of automatic fire-arms in warfare, but on that point he was silent; and although I was invited by the Chairman of the Council to provoke discussion on so important an omission, it was impossible under the circumstances to avail myself of the opportunity. And yet the gallant lecturer as well as his equally distinguished

brother, who was present and took part in the discussion, could on that occasion, as at other times before and since, have spoken to the powers of machine guns and descanted on their utility for service with perhaps more authority than most living Englishmen; for one of them at least personally witnessed the startling performances of an inferior nature of mitrailleur, handled with little judgment and opposed to a foe tactically as well as numerically superior. It may be said that the question of the employment of mitrailleurs in modern warfare, ably handled as the subject was by Dr. Gatling, Major Fosbery, V.C., and Colonel Fletcher, Scots Fusilier Guards, has been already discussed within these walls, and an open verdict given on their general adaptibility; but it is because the lectures alluded to were delivered at a time when the system was not thoroughly understood that once more the question is submitted to your judgment; and moreover we have added the sober reflections of three years to our knowledge of the gun.

I have, therefore, compiled this paper not as an exposition of dogmatic theory (however enthusiastic it may appear), but with a view to elicit the experienced opinions of others, and thus to gain for the members of this Institution and for the Army at large, the most authentic observations on an increasingly interesting subject. The title of my lecture will accordingly be pretentious in so far only as you respond to or decline the invitation. To effect this object I propose to consider present tactics as enforced by the experiences of modern warfare, interpolating suggestions as to the position of Gatlings, and thus with your assistance and corrective criticism to arrive at some conclusion affecting their status; for, individually, I hold that the Gatling battery should be regarded as an entirely separate and unique organization; as, in fact, a fourth arm of service. But before entering on the vexed question of tactics, I may be permitted to make a slight historical retrospect, so as to lay before you the facts connected with the introduction of the Gatling gun into modern armaments, a weapon, be it remarked, thoroughly and essentially different in all its distinctive features from all other fire-arms. It was the introduction of rifling, coupled with the uncertainty of fuzes, that brought about the necessity for an intermediate arm of service. "By depriving it of its most destructive projectile, canister," says Captain Henry Hime, in his *Artillery* prize essay, "rifled small arms have inflicted a heavy blow on field artillery, but "the evil is not irreparable, for the mitrailleur is capable of delivering "a fire of case far more extended and deadlier." The year 1869 was marked by unusual activity among nations in the investigation of rival systems of multiple guns.

But it is not my purpose to weary you with descriptions of the different mitrailleurs (as they came to be called, a generic term which by the way is apt to mislead) that were then previously or subsequently brought forward. No doubt they each had or have some speciality worthy of the inventor, and a principle may be correct which is simply spoiled in application; but my contention being that this "principle" has reached its culminating point in the Gatling

gun, I must confine myself thereto. In July of that year (1869), Gatlings of the larger calibres were experimentally reported upon both on the Continent and in America, and verified their unique character for continuity, rapidity, and accuracy of fire at long and short ranges. These were excellent results under the circumstances, and with the poor and imperfect ammunition of the period. It has, indeed, been to the simultaneous improvement of metallic-case cartridges that machine guns owe their present marvellous rapidity and certainty of discharge. In the following year it was ascertained by a special Committee, from a comparison of a series of trials carried out at Shoeburyness, under various conditions in regard to time and distance, that the destructive effects of a Gatling of small-arm calibre would be nearly three times greater than that of the 9 lb. field gun at troops in the open up to 1,400 yards. Moreover, the experiments clearly showed the deadly effect of this small Gatling up to 1,500 and even 1,600 yards, whilst the larger and medium sized Gatlings made good targets at 2,000 yards. These, however, were broad results of trials on level ground, without the distracting elements of strife, and could not be said to affect the particular hypothesis that machine-guns skilfully, courageously, and intelligently manipulated, would prove themselves unrivalled as death-dealing instruments amid the confusion and excitement of the battle-field. A second Report was therefore drawn up by the Committee on the 21st November, 1871, when the evidence of eye-witnesses to the action of mitrailleurs could be brought to bear on the question of their employment.

But the war that raged in the interval was not particularly conducive to the practical development of machine guns, because of the fact that no special preparation or tactical training had been devoted to the subject by the French Artillery Executive. The mitrailleur so mysteriously unveiled at Saarbruck effected but little to establish its reputation; and although on several after occasions, good service was performed by mitrailleur batteries, as at Wörth, Gravelotte, Beaugency, Sedan and Metz, the general results fell far short of Napoleon's, and, may I not add, of the world's expectations? It has, however, been remarked by more than one writer on the Franco-Prussian war, that French gunners were the least likely to do justice to a novel weapon of the kind, and to work it with calm intelligence. Be this as it may, the guns were not Gatlings, but mitrailleuses.[1]

On the other hand, the Prussians were content with their superiority in numbers and discipline, and dispensed with machine guns, except in the Army of the Bavarian Contingent, by whom a nondescript species of revolving cannon was nevertheless at times used very effectively.[2]

[1] A few Gatlings were, it is true, employed in the campaign of Le Mans, and at the siege of Paris, but they must have been of a crude and obsolete pattern, for the Emperor had some time previous to the war refused to purchase 100 Gatlings of an improved model offered to him by the Gatling Gun Company.

[2] "It produced a marked result at the affair of Coulommiers; one battery of four pieces causing, firstly, a battery of guns to retire when at a distance of from 900 to 1,000 yards; and further, repelling three times the attacking columns of the enemy."—Report of the Swedo-Norwegian Artillery Commission, 1872, translated by Captain King Harman, R.A.

The Prussians also captured a large number of the French type of mitrailleur, and when some of these were subsequently tried at Berlin, in competition with Gatlings and Montigne mitrailleurs, they were pronounced superior to either;—"an admirable conclusion to arrive at, "so far as economy is concerned," observes Captain Owen, in his recent pamphlet on Machine Guns, "but one scarcely borne out by "unprejudiced evidence." Major Charles Brackenbury may also be quoted on this head. He says:—"The Prussians alone, so far, deny "their value in the field, though they admit it for sieges. But the "Prussians never admit the value of anything that costs money, until "they possess it; and I can vouch for the fact, that the soldiers held "the French mitrailleuses—unwisely used though they were—in more "dread than the French Artillery." As however, it has, more than once, been broadly asserted, that mitrailleurs are regarded by Prussian Officers as superfluous engines of warfare, it may here be well to quote as evidence to the contrary, a few passages from the official work on the Franco-Prussian war, edited under the supervision of Count von Moltke, as translated by an Officer of the French Staff. In the great tactician's account of the battle of Gravelotte, he states:—"While "the action was thus developing upon the principal line of battle of "the 3rd division, three battalions of the advanced guard were having "a partial engagement in the vicinity of Chautreune. Two com- "panies of the 36th regiment had been led from Chautreune to the "slope which rises from the east, but, as in the wood, they did not "succeed in pushing further forward, for the open ground was entirely "under the fire of the French infantry, posted in the same wood and "in the cluster of trees west of La Folie and Montigne-la-Grange; "from this point notably, a battery of mitrailleuses swept the border "north-west of the cluster of trees, and another battery from the "south angle of this cluster, held under its fire the clearing which "separates it from the Wood des Genivaux. In a short time, General "v. Blumenthal saw the impossibility of an attack upon La Folie. "* * * * The position of the 36th Regiment on the open ground, "afforded it very little shelter against the enemy's musketry and "mitrailleuses, so its losses gradually reached a very high figure, while "the French generally kept themselves defiladed, or outside of the "zone of action of the needle gun." Further on he says:—"At this "moment the Artillery in position on the ridge to the south of the "Wood de la Cusse, was placed in an extremely critical situation. A "battery of mitrailleuses had debouched in front of d'Amanvillers, "and fired directly and with excellent range upon the extreme left of "the line of Prussian Artillery. This point was occupied by the "fourth heavy battery, already seriously injured by musketry; in a "few minutes the fire of the mitrailleuses so decimated it that several "Officers, 5 chiefs of pieces, and 40 men were disabled, and nearly all "of the horses were killed or wounded. Such was the situation when "suddenly large detachments of the enemy's infantry rose from the "ravine in front of the ridge, and threw themselves, with surprising "swiftness, upon the defenceless battery. Its chiefs already wounded, "succeeded, with the few horses still untouched and after desperate

"efforts, in getting two pieces back to the border of the wood; but "the remainder of the pieces fell into the enemy's possession."

Now, the foregoing is, I take it, a very suggestive quotation, and it is clear that on this occasion the French displayed exceptional good judgment. It will, however, be sufficient to draw attention to the fact that the 36th Regiment suffered losses from the mitrailleurs at distances beyond the effective range of the needle-gun, and also that guns of heavy calibre, in position, were completely snuffed out by volleys from another mitrailleur battery, stationed on an exposed ridge.

In accordance with the advice of Colonel Wray's re-assembled Committee, two natures of Gatlings were tentatively admitted into our service, namely, the one of ·65 calibre, for naval purposes and coast defences, and the ·45-inch, or ordinary Gatling, for field service. The Committee could, indeed, find no real fault with the former gun as a far-reaching and excellent machine for field service when opposed to artillery, but they thought that the weight of ammunition required to produce the highest results, under exceptional conditions, rendered its adoption inexpedient. Of course, so heavy a gun would, like the French mitrailleur, require more than two horses for its draught; but, in this connection, it is proper to remark, that the improved American Gatlings of large calibre, weigh considerably less than they did in 1871, that of ·65 calibre being 450 lbs. only. The difference of range between the small-arm gun and those of large calibre firing heavy projectiles, should also be borne in mind, when it is considered that our Gatlings may be opposed in the field to long-range mitrailleurs, such as the French ones, and not being able to reply to them, would be as discouraging as to be subjected to a distant cannonade from shell guns. It is, in fact, no longer possible to ignore the existence of mitrailleurs with the armies of all countries, every State in Europe having adopted some type of machine gun. Other nations have anticipated us in the extensive adoption of the Gatling for field service. Even Turkey and Egypt, China and Japan, Tunis, and Morocco, have procured armaments of this description, but Russia in particular possesses a formidable array. 400 Gatlings formed into batteries of 8 guns each, attached to the artillery branch of service, are, according to the information of our Intelligence Department, distributed as follows:—328 are stationed in European Russia, 48 protect the Caucasian territory (one of the batteries being assigned exclusively to the Cavalry) and 24 are placed in Eastern Siberia and Turkestan.[1]

[1] Why the Gatlings in Russia were named "Gorloffs" had better be explained, and indeed I have been requested by General Gorloff to disclaim, on his part, any pretention to the title of inventor. There is a rule in the Russian service that the name of any official superintending the casting or construction of a gun must be engraved on it. Hence the erroneous notion that General Gorloff altered in any way the mechanism of the Gatling. While at Hartford (United States of America) superintending the construction of the Gatlings for his Government, he experimented largely with the cartridges of the Berdan rifle (which is in partial use in Russia), and he succeeded in effecting an assimilation of ammunition (an important and economic provision which we would do well to imitate), but he did not tamper with the gun. Considerable changes, but no radical one, have been introduced in

During the Khivan Campaign, two Gatlings only were employed, but that they did good service may be judged from the following among other instances related by the Russian Officer, who had direct charge of the subdivision of the battery, as quoted by General Franklin, late U. S. Army, in a pamphlet lately published in America:—"About 3 P.M.," says Captain Litvinoff, "parties of horsemen com-"menced to make their appearance from different sides; they "approached us nearer and nearer, and behind them we could descry "larger masses. They commenced to engage our picket line with "great determination and daring. One of these pickets, composed of "1 Officer and 5 Cossacks, sword in hand, threw themselves forward "against an approaching mass of Turcomans and were completely cut "to pieces. Two companies of the 3rd battalion of sharpshooters, "two of the 8th battalion of the line, and two battery guns (Gatlings) "were ordered forward to drive away these bands of Turkomans. "The road we had to follow was very difficult even for infantry and "cavalry, as at every step we had to cross wide ditches, dug for "irrigation, which had abrupt sides; *for artillery the road would have "been impassable.* Our light battery guns went on this road with "perfect ease, the ammunition pack-horses alone giving us some "trouble. When we stopped, a line of sharpshooters and battery "guns was formed along one of these ditches. First I had to find out "the range; for this purpose I fired three cartridges, changing each "time the height of the sight; the distance found was between the "limits of 1,050 and 1,170 yards." Then he goes on to tell of his dispersing the smaller bands of Turkomans with very few rounds:—"Opening at the first, I fired rapidly 25 rounds; the band imme-"diately dispersed, part of the men joining the second band. Open-"ing from the second gun, I fired 50 rounds without interruption; "the second band dispersed at once, and the men betook themselves "to broken ground."

However, later they still came on:—"Several times the enemy "collecting in masses of some strength moved against us, but was "each time driven back by our fire; thus I had several opportunities "of firing a succession of 25 or 50 rounds, the direction of guns and "their elevations varying somewhat according to circumstances. In "the whole, the battery guns fired that day 408 cartridges." Not very many certainly, but the Russians had to be sparing of their ammunition as of everything else on that campaign.

But it is in the United States especially, that, as might be expected, the utility and economy of Dr. Gatling's invention has been appreciated. Two natures of the weapon have been issued to the American Navy, one with long and one with short barrels. Pivot-sockets are fixed in convenient positions on the rails and in the tops of large vessels, to enable the latter Gatling to be fired at an extreme depression for the repulse of boarders and for driving off torpedo boats. When

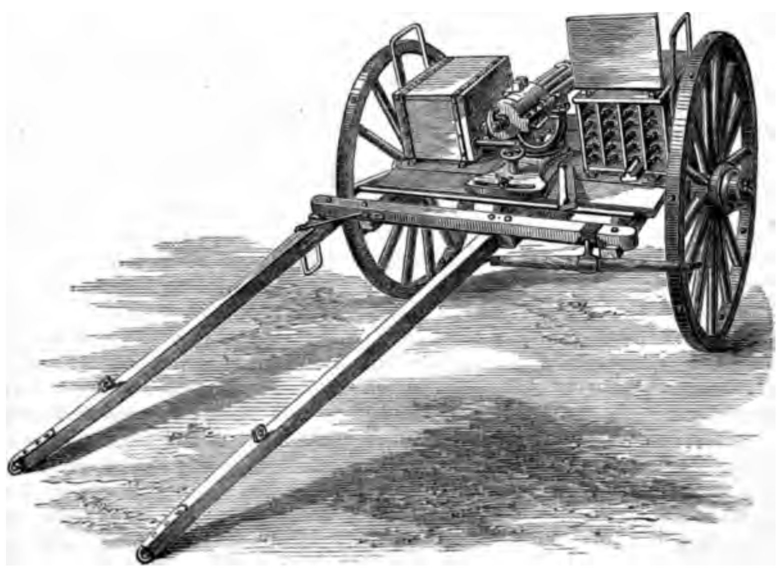
the construction of the Russian Gatling at the instance of a mechanical genius in St. Petersburgh, named Baranonski, in whose service are the Nobel brothers (*par nobile fratrum*), whose names have, in like manner, been given to the so-called improved Gatling.

either gun is used as a field-piece ashore, 13 men are assigned to the duty of serving and manœuvring it in action, the ammunition being conveyed in reversible carriages, and the men are drilled to load occasionally by hand, each man carrying for that purpose, 100 cartridges in a "passing box," slung over the shoulders; a rate in firing of 60 rounds a minute can be attained by this process of manual feed, during any interval in the continuity of loading from charged drums or feed-cases. As in our own service, steel screens are employed to protect the crank-men in ships tops, and mountings are fitted to the bows of cutters for the reception of the Gatling when used to cover a landing, or in river expeditions. "The Gatling gun, although an intricate "piece of mechanism to put in the hands of seamen," observes Lieutenant Marvin, U.S.N., the compiler of a manual on the subject, "is not liable to get out of order in service or have its parts deranged, "if intelligent care be exercised in its use and treatment." In the autumn of 1873, a series of trials to test the strength of the improved cartridge and the endurance of the Gatling, were carried out at Forts Munroe and Madison. The inventor of the gun stood by while 100,000 cartridges were being discharged, 63,000 of them being fired almost consecutively, and at times at a rate of 400 rounds a minute, without waiting to wipe out the barrels. The only mishap that occurred during this unprecedented test of gun and ammunition, was the breaking of an extractor hook, upon which Dr. Gatling at once withdrew the damaged lock; the firing was proceeded with to the close. Further experimental practices, to ascertain the value of the Gatling, in comparison with shell guns and small-arms, and for flank defence of temporary and permanent fortifications, were concluded last year, and the published account of the proceedings of the Committee, forms a complete vindication of the weapon as an auxiliary and indispensable arm for all branches of service. One passage only, have I time to quote:—"In field fortifications," say the Board, "a gun that can deliver a "rapid and intense fire, effective at both long and short ranges, is very "desirable. Indeed the power of guns to attain an enemy's column "at a long distance, obviates in a measure proportional to their efficiency, the necessity for using shell guns, or any other flanking "guns, at close range. If, in addition, this hypothetical gun shall "have proved itself capable, not only of *delivering* but of *maintaining* "uninterruptedly for hours, a most destructive fire at all distances "indifferently, from 50 yards up to and beyond a mile; its introduction into the armament of our fortifications, as an auxiliary, would "seem to be an obvious necessity. The Gatling gun is such an arm, "and is, beyond question, well adapted to the purposes of flank "defence, at both long and short ranges." In addition to a large number supplied, as I have said, to their Navy, for boat and shore service, 50 short-barrelled Gatlings have been issued for service with the United States Cavalry. Each gun is mounted on a light two-wheeled cart, so constructed as to answer the double purpose of an ammunition waggon. The cartridge boxes on either side of the gun contain together 40 feed cases, each holding 40 rounds, or 1,600 cartridges in all. Space is also reserved in front of the axle for two boxes

of cartridges, containing 1,000 each, so that the carriage can take with it a large supply of ammunition as well as the gun and a few necessary tools. [The accompanying illustrations (from photographs,) show

FIG. 1.

FIG. 2.



what a handy weapon it is for service in difficult country.] In the autumn of last year, two Gatlings were reported to have done "splendid service" in frequent encounters with the Redskins on the Western Frontier. On one of these occasions, Major Price, of the 8th United States' Cavalry, was attacked by 600 or 700 Indians, and he used his Gatlings with such excellent effect as to quite demoralize and drive off his savage assailants. Having thus summarised the history of the Gatling gun, it will be seen that hitherto the improved gun has only been employed against a foe ill-provided with artillery, or with no artillery at all; and let us consider for a moment, the advantage of such weapons for service under similar conditions in our Foreign Dependencies. It can indeed, scarcely be doubted, that as an auxiliary arm, Gatlings are peculiarly adapted to colonial defensive operations, as well as for retaliating demonstrations against troublesome neighbours, in countries where our enemies are numerous but ill-armed, where the roads are few and unsuited to wheel traffic, and where the surprise caused by the overwhelming discharge of a battery would carry with it an irresistible moral effect. More than 150 years ago, an Affghan Chief crossed the deserts of Kerman with an army, for the most part mounted on camels, a number of the latter bearing, in addition to their riders, a swivel gun. Approaching Ispahan, they encountered a Persian Army nearly three times their number and provided in addition with 24 formidable pieces of ordnance. On the Persian Army's approach, the left wing of the Affghans gave way; the former immediately pursued with vigour, but soon their enemies' ranks opened and disclosed a line of 100 camels kneeling down, each with a gun on its back. The fire knocked over the leading ranks of the Persians, and a charge of cavalry completed their discomfiture. Colonel Maxwell, R.A., who recounted this story some years ago to an audience at Woolwich, became, no doubt, unknowingly responsible for the hint as magnified by an American Artist, who has depicted an army of camels with short-barrelled Gatlings duly mounted, deployed for action on a vast plain in double ranks, front rank kneeling. The terrible effects of such a volume of volleys is, in fact, the only thing left to the imagination in the picture! But it was, I believe, at the serious suggestion of this same artillery officer, that Dr. Gatling planned the camel gun, weighing 135 lbs. only, and capable of being worked from a fixed tripod, or from the back of a camel or elephant.[1] Where range is of

[1] "In the mutiny of 1857," says Colonel Maxwell, "in India, and for some time subsequently, two camel corps, on Sir Charles Napier's model, were organised—one company being taken from the Rifle Brigade and another from the 92nd Foot.

"Could such corps, in addition to their power of locomotion, be endowed with increased power of musketry fire, their value, from a strategical and tactical point of view, would be vastly increased. Combined with cavalry, they would be more especially suitable to such operations as reconnaissances, as they would provide the reconnoitring force with precisely the element in which reconnoitring parties are usually deficient—viz., missile power and capacity of resistance in case of surprise; furthur, for suddenly seizing important strategic points such as the junction of a number of ordinary roads or railroads, fords, bridges; or for making requisitions, covering forage parties, seizing boats in a river, escorting convoys, and the like.

"As we have, in the north-west of India, a splendid breed of camels, it seems de-

secondary importance to portability, such a gun would display very valuable characteristics.

It, in fact, almost meets the requirements of Major Rait, C.B., who has suggested a "pistol Gatling" of 100 lbs. weight, to go on a light simple carriage; but as to this, I am inclined to think with Major Fosbery, that we ought not to sacrifice our command of ground and precision of performance, to the attractions of toy guns and feather-weight ammunition.

The specimen of the Gatling gun, courteously sent by Sir William Armstrong from the Elswick Works, for exhibition on the present occasion, has been expressly designed for the Indian Service, and weighs 150 lbs. It, too, can be fired from either a carriage or tripod, and I am assured it has been proved effective up to 1,400 or 1,500 yards. With the present traversing arrangement, the angle of lateral spread is 6° 4′, and this may be varied from zero to the extreme angle in intervals of 2°; an improvement will, I believe, be eventually introduced, to render the automatic device capable of any desired angle of spread. As you see, there are only eight barrels instead of ten; the effect of which arrangement is not only to lighten the piece, but to allow of a more rapid and continuous fire, in consequence of the freer circulation of air and radiation of heat. The angle of depression of the muzzles is only limited by the length of the elevating screw, and the convenient manipulation of the piece in action, but there is no difficulty in obtaining a depression of 10°, the carriage standing on level ground. The cartridges used with this light gun are precisely the same as those issued for the service of ordinary 0·45 Gatlings, and they will probably be carried in India on pack animals. No special mountings have yet been designed for the gun, but any ordinary field-carriage is available for the purpose.

The weight of our service Gatling, and the width of its track, precluded its effective use in the Ashantee War. One of the guns sent out was, however, mounted on an extemporized narrow-track carriage, and, although consequently top-heavy and liable to frequent upsets, it was taken to the banks of the Prah to command the bridge in certain eventualities. In bush warfare it is said that the pellet-drift from a Gatling would be ineffectual as compared with the heavier bursting deluge of a shell, but the former has exceptional penetrative capacities which ought to count for something. During the experiments in America last year, it was proved that at 150 yards the Gatling bullet pierced six thicknesses of one-inch plank, while canister balls, from a Howitzer, penetrated three only. Now the killing and disabling effects of a projectile may be said to be proportional to its penetrating power; therefore, in view of ever-recurring "little wars" throughout our widespread colonies, the non-employment of the Gatlings sent to

sirable to adapt their locomotive and carrying power to military purposes, in combination with the latest invention in firearms.

"The Gatling gun having met with the approval of a mixed committee of officers at Shoeburyness, it may be worthy of consideration whether a light gun on this system could not be made of a weight suitable for a camel gun."—"Camel Guns," Lecture by Lieut.-Colonel Maxwell, R.A.

the Gold Coast, will not, it is evident, militate against the future use of the gun before us, as an auxiliary weapon for offensive bush and hill warfare. Major Fosbery, has pointed out, very forcibly, the utility of mitrailleurs for field operations in India, the facility of their transport, the ease with which the great factories there can turn out any quantity of suitable ammunition, and the effects on the superstitious minds of the frontier-natives of an automatic straight-shooting field-piece as opposed to smooth-bore muzzle-loading cannon and inferior muskets; the excessive numbers of an ill-armed Asiatic force would, he urges, present the very conditions of success most favourable to their employment. And, again, in isolated posts and hill forts defended in troublous times by small and perhaps sickly garrisons or in the neighbourhood of large cities infested with turbulent populations, the mere presence of a mitrailleur battery could not, he thinks, be overrated. But as regards the use of Gatlings in European warfare, what are the points to be urged in their favour? Should they be disseminated among field batteries to act as far-ranging case-guns, or should they be applied as a collection of small-arms to the intensifying of infantry fire at critical moments? In other words, ought the Gatling be served exclusively as a field-piece or as a regimental automaton? When, where, and how can they be employed to the best advantage as multiple guns? Can they be used in attack, or must they be confined to defence? Should they be invariably entrenched and masked, awaiting the opportunity that may never arise, or should they risk exposure to be efficient? These are questions that naturally occur at the outset, but which could be answered far more easily from a negative point of view; that is, it would be less difficult to show what is beyond their capabilities. That Gatlings of small-arm calibre are exceptional, in their employment, must be allowed; they are of no avail against entrenched lines nor thick cover of any sort. They possess no incendiary powers, nor can they blow up magazines or smash waggons, nor do anything that the bullet from the best rifle cannot do. The Gatling is, in short, merely a life-exterminating weapon, and should be devoted to that object. Colonel Fielding puts it in a clear, though scarcely forcible enough light when he says:—"The Gatling represents a certain number of infantry for which there is not room on the ground "suddenly placed forward at the proper moment at a decisive point to "bring a crushing fire on the enemy." Major Fosbery is, I think, more correct and explanatory in his description. "Mitrailleurs," he argues, "are essentially labour and life-saving machines, enabling a few men "to do the work of a greater number, and better than the greater "number. They will do certain infantry work better than infantry, and "certain artillery work better than the artillery themselves." There is, however, a common-sense limit to this definition as supplied by the gallant Officer himself, when he adds the proviso that they should be introduced "neither as artillery nor infantry weapons, but as a class "apart, to assist both, but interfere with neither."

The question of organization is intimately bound up with that of the proper employment of mitrailleurs. As to this, Major Fosbery expresses the hope that we will not be persuaded to man and equip our mitrailleurs

as horse-artillery batteries; but, leaving them in their intermediate place, educate a separate class of men for their service, "taking, for "instance, drivers from the cavalry and gunners from amongst infantry "marksmen." Colonel Wray's Committee deprecated, while they proposed that twelve Gatlings should form a battery, that is to say, such an aggregate was only intended by them to be brought together for purposes of administration. The battery of twelve guns would thus be capable of being broken up into any number of parts to be employed ubiquitously where most required. It was further explained by Colonel Fletcher that two or three Gatlings were looked upon as the largest number that could be brought together in any particular place. In this opinion the Committee were followed by the Swedo-Norwegian Commission on mitrailleurs, who, while proposing that a battery should consist of four pieces, add the remark:—"Doubtless two mitrailleuses "could alone strongly reinforce a position; but it would be preferable, "in a case of importance, that a whole battery should be detailed, in "order that tenure of a position might not be imperilled by the dis- "mounting of one or two of the mitrailleuses by the fire of the enemy." The Committees agree in treating mitrailleurs as defensive weapons only, but the English Committee require, in addition, that they should be invariably entrenched and kept as far as possible masked from artillery fire, while the Foreign Commission recommend that such weapons should be kept with divisional reserves, and not be attached to brigades or battalions except under special circumstances. Colonel Hamley, while pronouncing Gatlings useless for offensive operations, would, for defence, employ a proportion of one Gatling to twelve field guns "to be kept in depôts and only moved into position when the "time for using them had come." Captain Owen, R.A., in consonance with the Foreign Commission, would have four Gatlings to constitute the tactical unit; bringing two of them together, if necessary, for larger administrative purposes under a major, or four under a Lieutenant-Colonel. Captain Henry Hime, R.A., suggests the addition of two mitrailleuses to our present six gun batteries, or the equipment of one of the divisions of our field batteries with Gatlings instead of guns. He also thinks that a certain number of mitrailleurs should be equipped on the horse-artillery system to act as batteries of reserve. Finally, Lieutenant Pratt, R.A., would not form Gatlings into batteries at all, but disseminate them among batteries of artillery. Such are some of the published opinions as regards the organization of these automatic weapons; and, diverse as they seem to be, they will serve to elucidate the text I have submitted to your unbiassed consideration.

It has been remarked that machine-guns seem to require an escort more constantly than field-guns to protect them from flank and rear assaults. If this be so, why, to meet the difficulty, could not a fourth arm of service, in its strictest sense, be organized? It might, in fact, consist of a judicious combination of Gatlings with a corps of mounted riflemen such as proposed by Colonel Wood, V.C., last year in this theatre. These riflemen, a specially trained and picked force, should not only act as escort to the guns, but as instructed Gatlingeers (a term I suggest as an obvious substitute for gunners), ready, on occasion, to fill up the

casualties that may occur among the Gatling Detachment. Combine, at times, a large force of cavalry with Gatling batteries escorted by riflemen, mounted on horseback or carried on long cars as described by Colonel Wood, and it will prove to be a very compact, self-contained, mobile, and effective little army for sudden and distant enterprises. On the other hand, a proposal has been made to attach Gatling batteries exclusively to cavalry. In a memorandum to Colonel Fletcher's lecture on the "Employment of Mitrailleurs," to be found in the 16th volume of our Journal, General Shute, C.B., points out the advantages of the arrangement. The alternatives as to whether Gatlings should be attached to infantry or form a portion of the artillery service are disposed of briefly in the negative; and he goes on to fortify his argument by the consideration that, in his corps, the required farriers, drivers, reserve of horses, and, in fine, the establishment of a battery, are already to hand; whilst he thinks that cavalry Officers who have obtained certificates from the schools of musketry would be competent (as no doubt they would) to command the battery on special service. As to the utility of Gatlings in conjunction with cavalry, he enumerates the several occasions of great moment in which the latter is so dependent on the co-operation of the other arms of service, as when acting as reconnoitring patrols or patrols in pursuit; and, during a retreat, when posted as a rear guard; also when advancing along roads and lanes, the flanks being covered by dismounted men. Besides, the General finally refers to the fact that as cavalry on the offensive manœuvre in open country this would also be adapted to the effective action of Gatlings. Batteries of horse artillery are either employed with advance and rear-guards, or with the cavalry of reserve. But as to this latter service, it is, I believe, undecided whether the guns would not be better employed in taking part in the general fighting, than by being kept back with cavalry, getting no opportunity for action. In such event, however, they would have to expose themselves within case-range to the enemy's infantry and mitrailleur fire; whereas Gatlings could manœuvre outside the range of the former; while, at the same time, producing far deadlier effects than the guns. So long ago as 1858, the prescient intellect of Sir John Burgoyne foresaw the employment of machine-guns in the field, and he recommended them strongly. He also proposed that the largest proportion of rifled field artillery should be of small calibre, and so reduced in size and weight as to be drawn on two wheels by two horses; in other words, the combination he laid such stress upon, is to be found in the Gatling gun before you.

It must be assumed that all Gatlingeers would be thoroughly conversant with the powers of their gun, for they must be prepared to take part with whatever branch of the Army is immediately in need of their services, and to carry out these duties with that arm with intelligence, care, and skill.

In the early actions of the great war, it is noticeable that the French used their mitrailleurs side by side with shell guns in the field, thereby encouraging the former to fling away ammunition at impossible ranges, and exposing them to the special attention which guns receive

in action. Instances of this fatal error might be multiplied; it will suffice to quote two or three from Captain Clarke's translation of the authentic records. Early in the day at the battle of Wörth, 84 guns of the 5th Division opened fire at from 2,400 to 4,000 paces on the French guns and mitrailleuses, when the latter, unable to reply were forced to decamp. Later in the day, when the 21st Division Artillery engaged at long range five French batteries, one of them being a mitrailleur battery, it was the latter the Prussians promptly silenced. So also at Spicheren, when Von Goben arrived, his six batteries of artillery directed their fire chiefly on the exposed but distant mitrailleurs of Laveaucoupet's artillery. To destroy mitrailleurs seemed to have been a favourite and not unnatural pastime of the overwhelming and well directed Prussian artillery; but surely this fact indicates the measure of their respect for the weapon, and is a strong argument in its favour, for, as Colonel Hamley enjoins, "guns should bear on that arm which threatens most."

In selecting a position the Commander of a Gatling battery would naturally seek temporary concealment, but to be effective he must emerge from cover, and to be safe, his shelter must not be of a nature to preclude immediate action against an assault. Before the enemy he must manœuvre within the range of artillery, but outside that of effective small-arm fire. Provided the ground in front is comparatively open, other conditions do not appear to be of moment. During the Franco-Prussian war, the best effects were produced when the mitrailleurs were posted on an eminence commanding the slopes of another and the intervening valley, or where stationed at the head of a ravine which had to be traversed by the enemy, or just within the verge of a wood on the flank of a position.

"Mitrailleurs and range-finders are imperatively demanded by "modern requirements," observes Major Brackenbury, "we have the "only good mitrailleur—the only range-finder at all; both of them "should be issued and tried at the Manœuvres." But it is not alone at the Autumn Manœuvres, but at private exercises over rough ground under every condition of attack and defence, that Gatling batteries can be prepared for the exigencies of service on occasions pronounced favourable to their effective use, bearing in mind that at distances proportionate to the size of the weapon employed (for Gatlings are of all calibres up to one-inch bore) they are capable of a more certain and continuous fire than any field gun. Among these capabilities may be enumerated the acknowledged power of the Gatling for the defence of entrenched positions and villages; for commanding roads, defiles and bridges; for covering the embarcation and disembarcation of troops, and for the protection of a column moving to its destination by railway; for silencing field batteries or batteries of position; for increasing the fire of infantry at critical moments, and finally for supporting field batteries and protecting them against cavalry or infantry charges. Lieutenant Pratt, when treating of the difficulties connected with the artillery of advance guards, adverts as follows to this latter duty of Gatling batteries: "where batteries of artillery "have to advance rapidly to the front to gain a good position it is

" evidently necessary for them to have a mounted escort; when they " have gained their position, infantry support is required. Advanced " batteries, then, require a double escort both infantry and cavalry to " be efficiently supported. By using a hybrid force, like the old dra- " goon or the mounted rifleman of the future, the difficulty is partially " obviated."

But he has a complete and instant remedy to propose: " Suppose " one of these," he subjoins after describing our service Gatling, " drawn by two horses, was attached to a battery, it would be escort " enough in itself. Where more than one battery is in position " effective cross-fire could be maintained. With two-horse waggons " for ammunition, the additional *impedimenta* to an army would be " trifling; and I think this weapon, owing to its mobility and efficient " defensive power, would be the most effectual escort to the artillery of " the future." The commander of a Gatling battery should know from habitual experience how best and most judiciously to give effect to the general directions he may receive for his guidance, but he should endeavour to keep out of fire until the moment for action is evident to his trained senses. Finally, he must, while seeking all immunity from the fire of artillery, in reality so despise it as never to be diverted from the main object of his presence on the field of battle, namely, the prompt slaughter of men and horses.

" This arm is chiefly of a defensive nature," report the Swedo-Norwegian Committee on mitrailleurs, " which, nevertheless, does not diminish its importance or merit, even in field warfare;" and, as corroborative of an assertion made earlier in this paper, they add elsewhere, " We cannot too strongly insist on the importance of not con- " founding mitrailleurs with artillery, as much on account of their effect " as the proper nature of their employment." Another point to which this Committee advert is the fact that the rapidity of fire produced by breechloading rifles has hitherto been utilized not so much in open combat as in the seizing of positions, villages, heights, edges of forests, &c., and a position attacked and taken one minute should the next be capable of defence against renewed efforts of the enemy to retake it. " However," remark the Commission, sententiously, " as " regards the United Kingdoms, this quality of the mitrailleur, that of " taking part chiefly in defence, should not be considered as a fault " but rather as a reason for its introduction amongst us." Is this not equally applicable to *our* United Kingdom? But, on the other hand, we should remember General Eardley-Wilmot's warning on this head, when he says, "If the system is to be looked upon for defence alone it " is likely there will arise difficulty in its application, as it will come " to be considered a mere reserve and will not be available at critical " moments."

As fearfully and conclusively proved in the latest contest, infantry will more than ever be employed in skirmishing order, for the breech-loader and the mitrailleur have forced close columns to deploy. Yet so lately as in the early part of 1870, Louis Besançon advised the deployment to be the primary formation of infantry at 1,200 yards and the distance not to be reduced, "except under the presence of

"superior power, so as to gain the full advantage from the Chassepôt." Had he been speaking of the mitrailleur he would in this have expressed its exact and rightful position, but of nervous, uncertain, excited riflemen, surely the idea is preposterous!

The effective sphere of infantry fire has been variously estimated as lying between 400 and 1,000 yards, but when we consider the many deterrents to good shooting, such as a moving object, smoke, fatigue, excitement, and attention to orders, the majority will be of opinion that 600 or 700 yards at the utmost is the reliable zone of accurate infantry fire action.

On the other hand, field guns, such as ours, would deal effectively with masses at ranges of from 3,000 to 4,000 yards, but they are as liable to error at short as at more extensive ranges. Hence it is Major Fosbery is of opinion that when posted in a defensive position there exists a distinct measurable space between the effective sphere of infantry fire, and the best effects of rifled field-guns which ought to be confided to the special care of machine-guns, as superior to either for the purpose. This area he fixes as lying between 600 and 1,200 yards. Thus an enemy advancing to the assault would have to pass through an organized fire action.

At the outset, shattered by the far-reaching fire of artillery with ascertained range and adjusted fuzes, as first line, second line, and reserves come successively into view, the enemy would have to pass into the zone of the mitrailleurs' fire, and finally be received by riflemen (with full pouches, strength, steadiness, and nerve, carefully reserved) within their most fatal distance. For the defence of such prepared positions, Gatlings have indeed been pronounced by the United States' Committee of last year, "superior to any species of artillery against "troops exposed to view;" and remember, too, that from its lightness the Gatling gun can be readily withdrawn from any point exposed to an overpowering or disabling fire, and be replaced in battery to meet the critical moment of assault. Of course, to be effective against field guns, the larger Gatlings would have to be employed, but even these ought never be opposed to artillery when there is more chance of being dismounted themselves than there is of preventing the service of the guns. This, however, is a moot point worthy of discussion. The Prince of Hohenlohe-Ingelfingen, himself an artillery officer, deprecates the exalted opinion of artillery fire formed by outsiders, "errors," he says, "of which artillerymen themselves are not innocent, because "proud of their arm, they are prone to ascribe higher qualities to it "than it really possesses." The French mitrailleur, composed of 25 large-bore encased barrels required the same number of men and horses as a field-gun, and yet Colonel Reilly, R.A., witnessed on one occasion one of these 6-horsed mitrailleurs standing in the open, exposed for 4½ hours to the much-vaunted fire of the Prussian artillery, unscathed and defiant. Artillery can smash the Gatling and blow up its limber, it is true, but how, if the gunners and horses be disabled during the attempt?

The course of a battle has been minutely described with reference to the action of the three arms by Prince Kraft of Hohenlohe, in his

pamphlet, as translated by Captain Clarke, R.A. Let us consider it for a moment, with this exception to the Prince's description, that we will credit both sides with acting on similar antagonistic principles up to a certain point.

In the offensive form of battle, the change from the march to the combat, occurs naturally enough. The advanced parties, whether cavalry or infantry, fall in with one another and commence the business, feeling each others pulse, as it were, and noting any indication of making a determined stand. The officers in command of the advanced guard on either side, then call for artillery, which immediately enter on a duel, occasionally sending shot or shell, at the rapidly reinforced first lines of infantry. Seeing this state of things, additional guns are ordered up on both sides, so as to delay the action for the arrival of the main body of infantry, and while the latter form up for attack, the guns are moved forward to closer quarters against that portion of the opposing line where the decisive assault is to be attempted. "If the form of the ground and the situation of the fight "are such that the chief blow must be struck in quite a different "direction to where the advance guard is engaged," says the Prince, "then the artillery of the advance guard will be charged with support- "ing the latter in the local objects of the fight, while the reserve "artillery will unite with the artillery of the main body to prepare the "principal blow." So soon as the position is sufficiently shattered and demoralization sets in, the main body of the infantry is pushed forward to close quarters, keeping up an incessant fire in conjunction with the artillery, until the latter is masked by the former and is obliged to turn its attention to some other object; to the enemy's guns or to any reserves in sight, or perhaps the great risk is run of continuing to fire shot and shell over the heads of the advancing mass, until the endangered region is reached. But here we must pause; for conjoint action is no longer possible. One party must win the day, and immediately the artillery of the conqueror moves forward to the captured position. Then cavalry and horse artillery follow up the discomfited foe and complete his ruin. Now this, I presume, is a fair exposition of the modern offensive combat, and let us see where Gatling's could be utilized during it. If cavalry move in front of an army and meet infantry, they are compelled to fall back for protection, whereas if associated with a Gatling battery, and its attendant mounted-rifleman escort, as suggested, important positions could not only be seized, but retained. If, from the closeness of the country, a body of infantry forms the advance guard, it too would frequently require the friendly aid of a Gatling battery to strengthen its fire at critical points, and in either case two or more Gatlings would prove efficient auxiliaries to the field batteries usually so employed, on the acknowledged principle that with advanced guards the most reliable gun is that which is most effective against troops and which can carry most ammunition; for it has to go into action first and remain there longest.

But then as the action develops into a serious general encounter, a further call for artillery is customary, and a duel is entered on, which,

according to the Prince, must be carried on within 2,000 yards, "with "any prospect of success," so that, if we employed such weapons, Gatlings of the larger size might then take part in the combat and be found useful to divert, disconcert and even silence the opposing field batteries. But by this time, as we have seen, the infantry have become engaged, and while the rapidly-reinforced first lines press forward, might not the Commander of a Gatling battery find a nook for the service of his guns on the flank of the supports nearest to the selected point of attack, ready to intensify their fire, and that of the main body when it arrives? or, if this would not be feasible, might not the Gatlings, at a later stage of the fight, and while the deployed battalions of the main body are marching forward to the assault, be moved into a position, however exposed, so as to continue their concentrated fire-action to the latest possible moment of final contact, the chief aim of tactics being to obtain the utmost development of accurate fire as the surest way of breaking down the enemy.

Again, it not unfrequently happens that the first assault of a position fails, or the enemy has only made a pretence of maintaining the defensive so as to put an end to attack by a vigorous counterstroke; confusion and perhaps retirement follow. This, then, would be the opportunity for a well-posted Gatling battery, and its timely aid might turn defeat into victory, for a sudden and well-sustained cannonade from an unexpected quarter will often change the fate of an engagement. Finally in the pursuit of the demoralised foe the Gatling battery might, in conjunction with horse artillery, convert the retreat into a complete rout. There is another phase of the offensive combat which seems to offer facilities for the action of Gatling batteries, namely, turning movements. "It seems not unreasonable to infer," observes Lieutenant Maurice, R.A., "that the whole defence will collapse as soon as small "bodies of assailants appear on the extreme flank." Thus it is likely that the General will profit by the mobility of Gatlings superior to that of field-guns to assist in such outflanking manœuvres. It is, therefore, in the spirit of the foregoing considerations that I venture to ask, would not Gatlings, under exceptional circumstances, contribute very powerfully to offensive tactics? Inseparably connected with the employment of Gatlings in the open, must ever be kept in view the conjoint use of tools for extemporising cover. In the Russian Service a few fascines are, I believe, carried on the limber, which may be readily arranged to mask the gun. If a wall or building be available, the Gatling can be worked from behind a loop-hole, and thus a few men would be enabled to keep a host at bay. In close country, such as surrounds the metropolis, interspersed with villages, parks, farm buildings, &c., there would be numberless opportunities for the right employment of Gatlings in this manner. In siege operations it is admitted that both for besiegers and the besieged, machine guns are most useful auxiliaries. During the siege of Metz, some Landwehr regiments were stationed in defence of the intervening villages of Ladonchamps and Tapes, against whom a sortie was made by the French. When the assault began, part of the 10th Army Corps was directed to advance to the relief of their comrades, which they did in

skirmishing order, and in columns of companies. "But," says the correspondent of the *Daily News*, from whom I quote, "the mitrailleur "venomously sounded its angry whirr, making the skirmishers recoil "nervously as they crossed the line of fire, and leaving chasms in the "front of the solid masses of which they were the forerunners." The French columns were, however, ultimately driven back. As usual, neither mitrailleur nor chassepôt (although they used the former "with rare judgment and effect") were of long avail against the overwhelming hosts of stern and stubborn Prussians. And herein lies the moral that Gatlings, however invaluable on occasion, must at all times be backed by a stalwart soldiery, reliable and invincible. The true strength of a nation is its manhood.

There is one other obvious opportunity for the right use of this weapon in the field to which I must allude in conclusion. To repel night attacks on camps or bivouacs, the Gatling gun is thoroughly reliable. A practical instance of its good service in this respect is related by the same authority from whom I previously quoted. During the Khivan Campaign, the column to which the Gatlings was attached moved forward on one occasion, leaving all its baggage packed in charge of a small detachment provided with the two Gatlings. At nightfall it was ascertained that the enemy lurked in large numbers in the vicinity of the camp, and accordingly the Officer in command took every precaution to prevent surprise. The baggage-waggons were collected into a square, and in a corner formed by the front and right sides he placed the Gatlings. At 3 o'clock in the morning the attack of the Turcomans commenced. "At the first howls of the "enemy," he says, "I hastened to form a cover for my guns. I put "on the right wing 10 privates, on the left 15 sharpshooters, and 12 "men of my battery guns command, with whom I could dispense for "the present. These men were also armed with rifles. Leaving thus "with the battery guns only the most indispensable men to assist in "firing, I took myself the crank-handle of the first gun, and invited "Captain Cachourin to take the handle of the other gun, and enjoined "on all my group not to commence the fire before the word of com-"mand was given. The guns formed an obtuse angle with one another, "as it was necessary to direct them to the precise spot where the "shoutings of the enemy were heard, and whence they were approach-"ing us. We had not long to wait. The cries of the Turcomans who "had succeeded in breaking through the lines of our detachment and "turning their flanks, suddenly rose from all sides, and became deafen-"ing. Though it was dark we perceived in front of us the galloping "masses of the enemy with uplifted glittering swords. When they "approached us within about twenty paces, I shouted the command "'fire.' This was followed by a salvo of all the men forming the "cover, and a continuous simultaneous rattle of the two battery guns. "In this roar the cries of the enemy at once became weak, and then "ceased altogether, vanishing as rapidly as they rose. The firing at "once stopped, and as no enemy was visible, I ventured to get a look "at the surrounding ground, availing myself of the first light of dawn. "At some distance to the right of our square stood the 8th Battalion

" of the line. Between it and us, at every step, lay prostrated the dead " bodies of the Yonoods, their hats being pushed up to their eyes. " *I saw no wounded.* They were probably all carried away according " to the usual Turcoman warfare." This is a significant and terrible, because simple account of facts, and fully bears out the destructive character of the gun. Mark, too, the immediate moral effect produced by this automatic manslayer. Its very snarl hushed the war-cries of the savage foe. It caused the Yonoods to reel in the saddle and wheel their fiery steeds back once more into the desert; all, that is, who did not bite the dust. I cannot fancy that they returned for wounded men, I cannot fancy that there were any to take away.

Surely, then, it may be conceded that Gatlings have a just claim on the attention of tacticians, and that the sooner its place be authoritatively assigned, the sooner will our men be skilled in its inevitable uses; for no foreign Army will in future take the field unprovided with a complement of machine-guns, and we must be prepared to meet them with at least equal weapons and superior tactics.

The days of obtaining any number of mercenaries to supplement our little Army, in case of European complications, have passed away. Nations are too jealous of their wants to overlook the exodus of any portion of their recruit-giving population. How then are we to fill the gaps created by the primary actions of a campaign; and how in future can we most promptly and economically prepare to resist invasion at home, while our ever-victorious Army is obtaining satisfaction for us abroad? Said the *Times* lately, " Conscription " in any country and in any form is the most cruel of all taxes, be- " cause it is a forcible interference with the natural course of existence. " If it can be avoided, any system is cheap which avoids it." Well, Sir, one object of my presence here to-night is to proclaim part of a system which shall meet the difficulty. Both the English and American Committees declared one Gatling to be equal on occasion to a company of average marksmen, that is, that two batteries of Gatlings, well served, are as effective as an entire battalion of infantry.[1] Is not the reasoning sound? it is at all events an *argumentum ad hominem*, for it dispenses, in a great measure, with his presence. We are burthened with an extensive coast line both at home and abroad, and for the defence of its integrity, Gatlings are, as an auxiliary arm, preeminently fitted. But is this all they are capable of—can they take no special part in active hostilities in the field?

We have, as you may see in the specimen before you, a light and perfect weapon of its kind, and which might well be issued for service in Europe as well as in India. Formed into batteries of six guns each, in the proportion of one battery of Gatlings to a brigade of artillery, and provided, in addition to their limbers, with two ammunition carts per battery, carrying in all an average of 4,000 rounds per gun, these guns, if placed not alone with the general reserves of an

[1] " Reckoned simply by the number of hits in the target, one 0·42-inch calibre Gatling, using the oscillator, is equal to 70 Springfield rifles firing against time, and 52 rifles firing deliberately. Without the oscillator, every shot from the Gatling should strike the target."—**Extract from Report of United States' Committee, 1874.**

Army, but on occasion with the artillery of the advance guard, or with a cavalry brigade to act in conjunction with horse artillery, would be available for service, at all events against cavalry and infantry within a range of 1,200 yards, and for critical opportunities at all times. "Many cases must arise in war," says Colonel Hamley, "in which the "long range of the field-gun would be superfluous, while the mitrail-"leuse could be employed under its own conditions of effectiveness. "In all countries not absolutely flat, troops may often engage with no "greater distance than 1,200 yards between the hostile forces."

There is yet another mode of utilizing to the utmost the powers of the Gatling gun. I have before now proposed that some regiments of our artillery auxiliary forces should be trained to their use for interior field operations, as well as for coast defence; and I venture on this occasion to renew the suggestion, not because I think Gatlings are weapons simple in manipulation, for they are not so; nor yet because they are likely to afford moral and material support (which is stated to have been the motive of the Austro-Hungarian Government for supplying mitrailleurs to their regiments of militia); but because Gatlings require the utmost intelligence, the most skilful handling, the readiest resource, the highest courage, and the best tactical genius that can be drawn to their service.

In much of what I have put forward in this paper, I have advisedly taken the unpopular, and according to the majority, the impracticable view of the mitrailleur question, inasmuch as I have suggested a claim for the Gatling to occupy a place in the preliminary phases of a battle. I do so, I can assure you, in no captious spirit, nor unmindful of the fact that any departure from defensive operations has been pronounced outside the province and mission of machine-guns, but perhaps you will think it only fair to discuss the doubtful as well as the certain contingencies affecting the possible status of Gatlings. No doubt each arm of service deems itself the exponent of the nation's prowess, and each in turn will claim the foremost place in the brunt of battle. It is a generous rivalry, a wholesome competition; but may it not be pushed too far, for in this contention it is likely that so valuable an auxiliary as the Gatling will be overlooked by each and all?

Distribute Gatlings permanently among divisional field batteries, and they will often be committed to engagements at ranges beyond their powers, and their very existence may be forgotten on occasions most favourable to their small-arm rifle character. Attach Gatlings exclusively to cavalry and they will sink into an inferior class of horse-artillery, again losing distinctive characteristics. Finally, post Gatlings in fractional sections to infantry, and, in addition, to difficulties of organization and administration, they will become a stumbling-block and perhaps a snare, for they may come to be regarded either too dependently or not at all. Depend upon it, if an hermaphrodite position be assigned to these weapons—if the pieces be dispersed capriciously as described, the Gatling will become not an auxiliary-arm but the scape-goat of the services. On the other hand, if distinct organization and latitude of action be allowed to them, so also, as I have endeavoured to point out, should the military education and tactical training of

Gatlingeers reach the highest possible mark. Yet even then it is to be feared that this application of the science of tactics, however varied and habitual, will fall far short of that practical experience and indefinable mastery of situations as they arise, only to be gained amid the smoke and carnage of the battle-field.

The CHAIRMAN: We have all listened, with great interest, to Captain Rogers' paper on the Gatling gun, and I would invite gentlemen who may feel disposed, to make any remarks that may suggest themselves to them upon the subject. I would specially call attention to the concluding observations of the lecture. Captain Rogers wishes it to be understood that he has advanced no special theory, but has stated the subject fairly, in an unprejudiced way, and is particularly anxious to invite criticisms and discussion on the matter.

Captain J. F. OWEN, R.A.: I am sure we all owe Captain Rogers very much for bringing this subject so clearly before us. He has collected the very latest facts which bear upon the Gatling gun, and, however we may differ from him in his mode of applying these weapons in the field, we all, I am certain, shall agree in one thing, that, if they are to be employed, it would be advisable to settle what organization should be used with them, as soon as possible. It seems to me that Captain Rogers has somewhat exaggerated the importance of this weapon, as to field warfare. We are here to-night to discuss the tactical use of Gatlings in the field, and not the use of machine guns in fortifications, or on board ship. With respect to that, I think there can be no difference of opinion. With respect to fortifications, for instance, the space in front of these guns, or any other ordnance that you have, is already cleared; but, in the field, we must remember that the least obstacle in the way renders such guns perfectly useless. It is not often that you have in the field a space prepared for the fire of a machine gun, as you have on the glacis of a fort or on a smooth beach, where you have to fire against troops who are trying to prevent a landing from boats. In such cases, the advantage of Gatlings is enormous. These weapons have little or no recoil, so that, both in boats and caponniers, where the space is restricted, the importance of their employment can hardly be exaggerated, though merely as a supplement to the heavier ordnance. In the field, however, the case is very different, and the question is, whether the disadvantages do not more than counterbalance the advantages of taking any number of Gatlings with an Army in the field? In a battle, for instance, it would be a great advantage to the artillery to have a very heavy gun to reach the enemy's reserves, and to silence his field guns at great distances, but we know we cannot take heavy guns of that description into the field, the impedimenta are too great. The question for us seems to be, are the advantages of the Gatling such as to counterbalance the disadvantage of taking extra impedimenta into the field? Their range is very limited; between 650 and 1,000 yards, Captain Rogers lays down as the distance where their fire would be effective. That is a very small space. Beyond that they would be of little or no use, while artillery is not only formidable beyond 1,000 yards, but even within that range its case-fire would be very effective. Still, no doubt, as a supplemental arm to the artillery, the Gatling would have its uses, but I think we should limit its numbers. As to organization. Captain Rogers suggested a very anomalous sort of organization, the absolute establishment of a fourth arm, as far as I understood. I do not think, as a rule, we could agree to establishing a fourth arm, when we have an arm ready to receive such a weapon. It is, in fact, merely a light field-gun, and, in that way it is employed by those powers who use it on a large scale. The French have so used it, the Russians, in their organization, have one battery armed with mitrailleurs in each artillery brigade, and so they have in Spain. One or two other points I should like to allude to, for instance, as to the tactical use of this weapon in the field. Captain Rogers proposes that guns should be protected by mitrailleurs, on their flanks. Surely, we can scarcely feel that a battery of artillery would be safely guarded by a Gatling on each flank. It is very rarely that the space in front is fitted for the employment of such weapons; unless the country is carefully prepared beforehand, it would not answer. Then, how about the enemy's skirmishers creeping round the flanks, under cover? The Gatling would be useless

against them, whereas, if you are protected by an infantry escort, the infantry could throw out skirmishers to meet the enemy. In the Franco-Prussian war, batteries of mitrailleurs were, on several occasions, captured by the enemy's skirmishers reaching round their flanks. If they are not able to protect themselves, they would not be able to protect a battery of artillery. That is quite clear. I cannot agree in the advisibility of so employing mitrailleurs. There is still another point I should wish to allude to, viz., the training of the men who are to use these weapons. They should undoubtedly have a special training; and anybody who has examined the mechanism of those pieces will agree with me that it requires skilled men to work them. In whatever way, then, we treat Gatling guns, they should not be placed in the hands of men who are not specially trained for their use, and the reasons are all the stronger for special organization, and for not mixing them up with either infantry or cavalry.

The CHAIRMAN: I would draw attention to the fact that Captain Rogers has denominated his paper, "The Gatling Gun; its Place in Tactics." I think this title includes naval as well as military tactics and I notice, in one or two places in the paper, that he has alluded to the use made of the Gatling in naval warfare as well as in the field; therefore, if any gentlemen will favour us with remarks in regard to naval operations connected with the gun, we should be glad to have the benefit of their views on the subject.

Major HALE, R.E.: There is one question I should like to ask the artillery Officers here present—whether they consider the Gatling gun, at short ranges, superior to their own field-gun? In my humble opinion, it seems out of the question to use the Gatling at ranges beyond effective infantry fire, because, directly the Gatling gun opens on the distant infantry, the enemy's field-pieces could open on your Gatling gun; therefore, the Gatling must be kept under cover until the very last moment. The last speaker talked of it as a field-gun. I look upon it as ten nerveless infantry soldiers. The Gatling gun should be used where the enemy's artillery can no longer attempt to silence it, when the enemy's infantry have got so close to your position as absolutely to mask their own fire, at that point when your own men's nerves begin to fail; that would be in the defence of a position within case-range. Of course, if the artillery think their case-fire, or can prove that their case-fire, is superior to the Gatling, then, by all means, let them use their guns instead of the Gatling; but if the Gatling is superior to the artillery field-piece at close range, then, in defence positions, the Gatling surely should be used. Artillery Officers are particularly anxious to impress upon us that the Gatling is of invaluable service in caponniers, or the defence of ditches. There they quite admit it is far superior even to ordinary field artillery. Whenever a battle is fought, one side is always on the defensive. At some period of the engagement, the enemy are coming quite as close to the defensive side as ever they would be in a ditch of a fortress; therefore, out of their own mouth, do I condemn artillery Officers, and say that there are certain cases on a field of battle on which the Gatling is superior to their own field-piece. Then comes the question, who is to make use of the Galting gun? The artillery like it and do not like it. They think they must take it, and yet they do not quite like to take it. The cavalry, they have nibbled at it, but I think most of us are of opinion that it is hardly a cavalry weapon. The infantry, I do not think they very much care about it, for the great feature of infantry is mobility. I ask, whether such a weapon will make a battalion particularly mobile in the field? The lecturer has recommended the formation of a fourth arm of the service to take charge of the Gatlings, but there is already a fourth arm of the service, called the engineers, and, if nobody else will take the Gatlings, why not try whether they can take charge of them, rather than let the weapons be lost for want of some one to father them. The engineers are specially defensive; they have got a train already; it is their duty, directly a position is taken up, to occupy a village or the strong points in the position. Why not give a couple of Gatlings to the engineer train? Why not, when a company of sappers or a German pioneer company is thrown into a village for defence, or are told to occupy a wood, why not let them have their couple of Gatlings by them, and put them under cover, in the best possible positions for defence?

General Sir ROBERT PERCY DOUGLAS, Bart.: I think a very important question

is raised by the last speaker, and I should be very glad to hear some military Officer answer it, because in the first part of this paper we heard words, such as "super-"cession of artillery," and "snuffing out artillery." I was glad afterwards to hear the lecturer say, that this was not to supersede the artillery, but was to be an auxiliary arm. I think it would be very valuable if some artillery Officer would reply to the question put by the last speaker, whether the Gatling would in certain ranges, limited say to between 600 and 900 yards, be as efficient or more efficient than their own case?

Captain OWEN: I feel that I am trespassing very much upon this meeting in getting up a second time, but I do not see any other artillery Officer here who is prepared to do so. Of course we all admit there are occasions on which the weapon before us, may be of great importance. No artillery Officer would deny that there is a certain range, say from 600 to 1,000 yards, in which Gatling guns are very formidable; but the question is—whether their disadvantages do not more than counterbalance those advantages when you consider that the larger an army is, the more difficult becomes the task of the General as to its impedimenta. We can only take a certain number of wheeled carriages into the field. Is it advisable that as many as possible should be field artillery, capable of engaging at any range up to 3,000 yards, or only such weapons as we see here with so limited a range as to be only useful between 600 and 1,000 yards? If we could carry both, no doubt we might do it advantageously, but we are tied down. The question I repeat is, how many pieces of ordnance can we take with advantage into the field? If we could take these guns, and take field-guns and heavy guns as well, and employ them all three, so much the better, but we can only take a certain amount. As to the employment of the Gatling with the engineer corps, of course that is not for me to talk about. It is not, I think, the usual idea that sappers and miners should have a gun of any sort, but I can venture no opinion upon that point. Caponnieres have been referred to, and we are told, because an artillery Officer says that a mitrailleur is a most excellent weapon in a caponniere, therefore he blows hot and cold when he says, that he does not consider it can be used in the field, except in very limited numbers. I think that is a total misapprehension, because in the fortifications, where caponnieres occur to protect a flank or ditch, the fire is necessarily limited to a certain range, the very range at which these pieces are so useful, say between 600 and 1,000 yards. A field-gun in such a position would be thrown away. Being only able to fire up to a certain range, what would be the use of having a piece which could fire further; therefore, I say, in a position where you cannot gain any advantage by the longer ranges of a field-gun, it is well to use a lighter weapon of the nature of the Gatling. The absence of recoil also makes it valuable for such uses where your space is confined, though it is a matter of small importance in the field where you have plenty of room. That is one of the reasons why, if I may again say so, artillery Officers are not inconsistent where they do not think it advisable to take a large number of Gatlings into the field, and yet say, that in certain posts for defence they may be of the utmost value, and that undoubtedly in the caponnieres and flanks of some fortresses, and also on board boats, where space is limited and recoil of importance, these weapons may be be very useful.

Major HALE: Will you tell us, whether they are more effective at case-range than ordinary case?

Captain NOLAN, R.A., M.P.: I saw most of the Gatling experiments at Shoeburyness, and I do not think artillery Officers claim very much for case beyond 130 and 200 yards. I should be sorry to say it is more destructive than one of those Gatlings, but it is destructive up to 130 yards. We, in the artillery, have now lessened the powder-charge that drives the projectile, and when we come to use case, just as firing shot of a fowling-piece at birds, we drive the canister with less force than formerly, so at the present moment the decisive effect of our case has actually fallen off from three to six hundred yards (the range of the old Peninsular case), down to 130. Certainly the Gatlings had quite the advantage over artillery at Shoeburyness between that and 600 yards, and also up to 1,200 yards, but not to such an extent; after that they began to fall off. There are other questions raised. People seem to fancy the artillery must have some special objection to the Gatling because they do not adopt it at once, but the difficulty is this,—supposing you take half

Gatlings and half guns into the field, what would be the position of the artillery with half Gatlings and half guns? If, on one side, there were 200 guns, and on the other side, only 100 guns, the 200 guns would destroy the 100 guns in about twenty minutes, consequently, any artillery would be very slow to have even twenty guns less than its opponents, if it could be possibly helped, and it would be very difficult to bring the Gatling into the field without displacing artillery. That is the real objection of artillery Officers. It is not that they claim that the guns are more destructive to cavalry or infantry than Gatlings, but because they are of very little use in an artillery duel, and an artillery duel will generally precede every engagement; to have the Gatlings, they must sacrifice the same number of guns, and a few guns, more or less, make all the difference in an artillery duel, where the preponderance goes on in increasing ratio every moment, as some of the pieces of the weaker artillery become silenced. As to the engineers taking over the Gatlings, of course the engineers are quite clever enough to manage Gatlings, and if they choose to take up Gatlings, and to look after the horses, and go to the stables, and everything of that kind, they would no doubt become excellent Gatlingeers—I should fancy they would become excellent gunners, but perhaps they would cease to be engineers. One of the gentlemen who spoke called them pioneers, and he objected to infantry losing mobility as they would do if they had the Gatlings. Now men who are pioneers are supposed to go before the infantry, and consequently, I fancy they would lose their mobility in a still greater degree. There is no doubt if engineers had the Gatling, they might beat the artillery in the long run, but I think in doing so they would cease to be engineers, and would become gunners.

Major HALE: I used the word "pioneer companies," not "pioneers."

Admiral Sir HENRY CODRINGTON, K.C.B.. You put a question, Sir, relating to the Navy. It is difficult to see how this weapon can apply very much to the Navy, that is to say, in a way sufficiently important to make it desirable to have Gatlings on board. The style of fighting our successors will have to go through is decidedly not one in which that sort of instrument would come into play. We are supposed to be fighting now in very thick armour, and not to show ourselves outside that armour. Our dangers are, as our powers are, ramming, or perforating with very large heavy missiles; and that is the only means apparently by which we can act or be acted on, one ship upon another. I do not see, therefore, how an instrument of this sort, however well managed, can be made available in seagoing warfare. Then comes the question, how far it is available in connection with the shore? That is partly a soldier's question. I can perfectly see that putting it into a boat would give that boat the power of very large musketry fire, and so far would help a landing; but I cannot help thinking that one Gatling on the beach would be much more likely to prevent a landing on that beach than one Gatling in a boat would facilitate that landing. I do not therefore see that there is yet very much to be gained in the naval service by having this new arm. I do not know that we want it yet. When we want it we shall ask for it, and perhaps may get it, but I do not see the want of it yet.

The CHAIRMAN: There is one point Captain Rogers alluded to, namely, the use of the Gatling arm in warfare against savage tribes, or any desultory warfare. He drew attention to the operations of the Russian army against the Turcomans. I do not know whether any gentleman would wish to make any remarks upon that portion of the subject.

Captain BURGESS: Captain Tulloch, of the Royal Military College, who is unable to be present, has sent in the following note on the Gatling gun. He says, "The "Gatling gun is peculiarly adapted for the use of volunteers on account of the "expense of horsing field batteries, and the amount of drill required before "volunteers can efficiently man them. The Gatling is well suited for defensive "positions, such as would be held by volunteers in the event of invasion. At that "time the Royal Artillery would be required elsewhere."

Sir PERCY DOUGLAS: On the question of the use of the Gatling gun and its applicability to warfare against uncivilized people, from my experience at the Cape, I can say it would be very valuable. I have no doubt one gun of that sort, with a very few men, would hold a post against any number of natives. It would have this disadvantage, that it makes such a horrible row in going off that it would frighten

the foe away; whereas, you want them to stand, so as to get hold of them. It would no doubt strike great terror into these people. The only thing I am afraid of is that none of them would stop. For the defence of small outposts, no doubt it would be most valuable. I would also allude to the facility of transport through a country which artillery cannot well traverse. In such cases these guns would be found very useful.

Captain Rogers: I have very little to say in reply to the remarks that have been made on this occasion. I am greatly indebted to those gentlemen who have taken part in the discussion; and, so far as I have heard, I think the observations brought forward on the subject have been supported more or less by the Officers who have spoken. Captain Owen remarked upon my not saying anything as to the use of Gatlings in fortifications. It was simply because it was a foregone conclusion. His own book takes it as a foregone conclusion that they are of the greatest use in fortifications and for repelling sorties, and so forth. He said, also, that they would afford no protection to guns because of their liability to be attacked by skirmishers. On that point I simply quoted an artillery Officer, Lieutenant Pratt, who thinks that a Gatling gun attached to a battery of artillery would be very useful for driving off skirmishers on the flanks. Of course they must be supported also by infantry or cavalry; and, besides, he mentions that hybrid force, the mounted riflemen of the future. That is a phase of the question that had better not perhaps be brought forward yet, because it is still in the future. Sir Percy Douglas misunderstood what I said about snuffing out artillery. I merely quoted from the official account of the Battle of Gravelotte, where mitrailleurs knocked over so many horses and men that the battery of artillery had to retire.

Sir Percy Douglas: I misunderstood you: I thought you were making a general application.

Captain Rogers: I think the other remarks were generally in support of what I brought forward; and, at this late hour, they need not be adverted to.

The Chairman: I may be allowed to express the feelings of the meeting in returning our best thanks to Captain Rogers for the trouble he has taken in bringing the subject before us. I think the conclusion appears to be very much the same as that at which the Committee on the Gatling gun arrived, namely, that it is inadvisable to reduce the number of artillery; that although fully recognizing the difficulty of increasing the impedimenta of an Army by adding further wheeled transport to that which already accompanies the Army, yet that there is still a place for Gatlings in modern warfare. Of course it is a most difficult matter to ascertain what that place is, or how they had best be used; but the opinion of the Committee certainly was that there were certain positions where Gatlings were useful, and they recommended that a small number of them should be attached to an Army in the field. The whole question with regard to artillery is a most important question at the present time. Only a short time ago I had an opportunity of having a long conversation with General Sheridan of the American Army, who had had great experience in every arm of the service in the late American War, and who supplemented his experience by being a spectator of the late Franco-German War with the German Army. His opinion was, that it would be necessary to reduce the wheeled transport of an Army, and still further to reduce the artillery. He advocated an increase of mounted riflemen. I merely instance this as showing the condition of things with regard to the several arms of the service, that not only with reference to Gatlings, but also the other arms of the service, there are still many doubts as to what proportion they should bear in armies of the future. I trust we may conclude this meeting by expressing our thanks to Captain Rogers for his valuable lecture.

APPENDIX.

It has been thought advisable, and perhaps interesting, to subjoin a short description of the Gatling gun and its working.

The model Gatling exhibited at the meeting consists of eight (usually there are ten) simple breech-loading rifled barrels revolving round a central shaft as a common axis. Each barrel is loaded and fired, and the empty cartridge ejected automatically

once during the continuous revolution of the system. There are as many locks as barrels, and the cam (which is a principal feature in the interior mechanism) causes a reciprocal motion of the locks, whereby each in turn moves forward in the act of revolving, and performs the functions not only of an ordinary lock, but also of breech-plug and extractor; thus four locks are in different stages of discharging the cartridges, and four of withdrawing the empty cases during each revolution.

The working of the gun is as follows:—One man pivots a charged drum (as this cylinder is called) on the pintle above the hopper, while another turns the crank-handle. The bottom of the drum is unkeyed, and the cartridges of one division (the drum being divided into 16 perpendicular columns holding 15 rounds each, or 20 rounds as in the American gun) drop successively into the grooves of a carrier-block in front of the chambers of their respective barrels, upon which they are, as it were, seized and acted upon by the locks as described, that is, driven forward into the barrels, discharged, and withdrawn instantaneously.

The drum is revolved by hand (in the Russian service it can, I believe, be revolved mechanically) until the 16 divisions are exhausted. Straight feed-cases are used with the American 0·45 Gatling (see Fig. 2), and with the Russian field Gatling in preference to the drum. These feed-cases, which are recommended for all calibres on account of their facility for packing and transport, contain 40 cartridges. Either drum or feed-case can be promptly withdrawn and another loaded one substituted without interrupting the revolution of the barrels, locks, &c., and therefore the intensity of fire is merely dependent on the activity of No. 2 in manipulating the drum or feed-case; a rapidity of from 350 to 480 rounds a minute has been easily attained, and, as I have been informed by General Gorloff, the Russian Gatling is capable of discharging as many as 600 or 700 rounds a minute; but it is of course the capability of firing at this rate occasionally, that should be considered, rather than the fact that so many bullets can be poured forth in a continuous stream within a given time. The normal rate of firing should rarely exceed 240 rounds a minute, particularly if the front be a narrow one or if the object aimed at be a compact mass. The locks are interchangeable; and, should any get out of order, they can be withdrawn and others inserted in their places through an orifice in the cascable plate within a few minutes, but the absence of one or more locks does not affect the working of the gun, as for each lock removed, one unexploded cartridge merely drops to the ground or into a bag affixed for the purpose.

The automatic traversing apparatus (which I was unable to exhibit owing to the absence of a field-carriage and the extemporized platform not admitting of the fixture being adjusted) is simply a cylinder slipped over the crank-axle having a cam-groove on its periphery into which a circular pin enters, this latter being attached by an arm to the elevating screw. When the crank is turned, the cam-groove travels to and fro on the pin, swinging the gun with it, and thus a dispersion of fire of twenty feet in 100 yards is obtained if necessary, but this lateral spread can be reduced as before described.

One word more. I was asked how, if there were danger of the gun falling into the enemy's possession temporarily, would it most readily be put out of gear, as the drum would be too heavy an article to run away with (its weight, when loaded, is, in fact, 50 lbs.); and I suggested to hammer the pintle on one side, which would have the same effect as spiking a gun; but, obviously, the readiest mode would be to remove the crank handle.

April 27, 1875. E. R.

P.S.—While the foregoing has been passing through the press, notice of a new American Torpedo vessel has appeared, in the armament of which the Gatling gun forms a prominent feature. This vessel is called "The Alarm," and carries one 20-inch gun in the bow, and when fully equipped she will have four Gatlings on board. We have, as yet, but few Gatlings in our naval service, which, as mentioned in the text, are placed in the "tops" of ships of the "Monarch" class, while a few lighter Gatlings will be mounted for boat service in the bows of cutters.—E. Rogers.

Evening Meeting.

Monday, April 26th, 1875.

His Grace the DUKE OF SOMERSET, K.G., in the Chair.

NAMES OF MEMBERS who joined the Institution between the 20th and 26th April, 1875.

ANNUAL.

Whyte, William H., Capt. R.N.
Walker, G. F., Lt.-Colonel 12th Regt.
Johnson, E. B., C.B., Major-General R.A.
Hayward, J. F. Curtis, Capt. 25th Regiment.

NAVAL GREAT GUNS AND GUNNERY.

By John Scott Russell, Esq., F.R.S., &c., &c.

I consider it a great honour that this Society, consisting of distinguished soldiers and sailors, has asked me to lay before them my views on Naval Guns and Gunnery. I sincerely sympathise with your professions, in the changes, not to say revolutions, you have been obliged to make in the weighty matters of your professions. I have already had to go through the same severe ordeal in my own profession. The principles which I was taught in my youth, and the practice in which I was trained in my earlier professional life, have all become obsolete, and a ship of modern times has scarcely any resemblance to a ship of past days. Within the last twenty-five years, I have had to abandon all the older constructions, both of ships for merchant service and ships for war, and have had to unlearn nearly all my old prejudices, and to invent or to apply entirely new principles.

You are now being obliged to suffer the same change in guns and gunnery, that I have undergone in ships and their equipment. My experience in guns has been chiefly in naval guns. I had formed a very high opinion of our old naval guns; the long 32-pounder, the 65-cwt. 8-inch gun, and the 95-cwt. gun, were especial favourites of mine, especially the 65-cwt. 8-inch gun. In all the war vessels I have built in which the choice of armament fell to my duty, I adopted the 65-cwt. 8-inch gun as that out of which I got most useful work. For exceptional long range I used the 95-cwt. gun of 8 inches calibre. In my opinion, these were perfect guns of their size and of their time.

What I propose to lay before you to-night is the special question, What should be our new naval gun, to take the place of my favourite old 8-inch guns? Now the choice of the right gun for your use lies with you, not with me. You know what you want the gun to do; you know what size and weight of gun you can manage. All I will presume to do is to lay before you the advantages and disadvantages which belong to one kind of gun, and not to another nature of gun.

The two important points I first want you to settle this evening are

these, What weight of gun can you accept as the manageable weight of gun? Next, What work do you want the gun and its projectile to do? If you settle these two leading points, I think I can see how all the rest can be done.

First then, according to your knowledge and experience, what weight of gun can you handle at sea with the aid of the best modern gun carriage?

From all I have been able to learn of experienced practical opinion on this point, you can easily go to 12 tons weight for the naval gun. Twelve tons is a great weight; but with the system of modern pivoting and modern carriages, it is, I think, quite practicable. If you take 12 tons as your limiting weight, I will accept it as a settled quantity, and enter on the important questions which follow: What shall be the bore of this gun? its thickness, its length, its charge, its shot, its work come later.

Now the choice of bore is of radical importance. We have in our service—and other nations have tried—every bore of gun from 8 to 12 inches, with every variety of weight from 6 tons to nearly 40 tons. I think I express your own opinions when I say that it is not at all clear that any one of these is a gun which you are content to accept as the naval gun of the future English Fleet.

I will, therefore, now ask you to consider this one question of a gun of 12 tons weight of metal, and settle whether you will accept for it a small bore or a large bore. As small bore, let me say 8½ inches; as large bore, let me say 12 inches. Our question is, whether for our naval purposes the smaller or the larger is the better?

When I ask the reason why greater progress is not made in naval artillery, and greater progress is not made in some points which I think are improveable, namely in the construction of ships of war, I am continually told by our legislators and authorities, that the one reason they do not get on faster with naval guns and with the construction of ships is, "that the sailors whose business it is, do not "know their own minds and have never made up their own opinions, "and if you ask them, they can neither tell you what sort of ship they "want, what they want it to do, what sort of guns they want it to "carry, or what they want to do with their guns." They say that—I know it is not all true; I know you have each made up your own mind thoroughly upon these points, but I am afraid there is some truth in the observation that you do not quite agree. I hope you will not think me foolish and sanguine if I hope that either this evening, or if we cannot make up our minds this evening, perhaps at a meeting to-morrow evening, we should together make up our minds and say we are of one mind, "we want this gun, for *the naval gun* and no "other." I say to you, if you will settle what you want and agree in it, I am quite sure I know clever fellows enough in England, clever builders enough, able enough contractors in England to undertake that if you say what you want "you shall have it." Excuse my interpolating this observation, but I do so to say that I come here this evening with an earnest hope that you will after an ample discussion settle absolutely what it is the profession wants.

Now before choosing, it is well to draw a line of some importance, between guns to be used by soldiers on land, and guns for naval service at sea? The difference in conditions is this, that guns on land have a steady platform; on sea they have a moving, heaving platform. This distinction is most important for our purpose. Suppose a gun being built expressly for a fixed land battery, say for the defence of Dover, or Portsmouth, or some other harbour; extreme long range of gun might be of great exceptional value in such a case, and worth a large sacrifice. One gun of 5 miles range might be worth 10 guns of 3 miles range; but on board ship, as a rule, the man who would fight his battles at so great a distance, would not be wise, for he would certainly waste his fire. If I understand sailors aright, what they want is, guns that will fire quick, with great destroying power of shot, so as to pierce the enemy, damage, and sink him within a moderate range and with least waste of time.

To secure *most execution at moderate and sure range* seems to me the essential character of naval gunnery as distinguished from land gunnery. If that be agreed upon, I now proceed to see how we can get most use for that end out of our 12-ton gun.

I say then at once, that you will get much more practical good out of your 12-ton gun by giving it a large bore of 12 inches, than a smaller bore of $8\frac{1}{2}$ inches.

In a 12 inch bore, the powder-power propelling the shot is 144.

In an $8\frac{1}{2}$ inch bore, the propelling power is 72.

Or the work done by the 12 inch bore is double that done by the $8\frac{1}{2}$-inch bore.

For the present I confine myself to this statement; I will prove it later on.

Next, I will take the question, how shall we turn this double propelling power to account? We have two ways, to send out a heavier shot, or to send out the same shot with higher speed.

Now in regard to weight of shot I may observe, that as you have fixed the weight of gun I shall consider the weight of shot as fixed also. Your gun weighs 12 tons, that is 240 cwt. Now, according to the best practice in all countries, the normal shot is 1lb. of shot to each 112lbs. of gun. This gives for the 12-ton gun 240, or 12-ton gun (240 cwt.) 240lb. shot.

Taking, then, 240lb. shot in an $8\frac{1}{2}$-inch gun, and 240lb. shot in a 12-inch gun, we have double the powder power propelling the same shot; or double the propelling force pushing forward the base of the shot. Therefore, the same weight of shot will be discharged with much higher speed.

Now speed of shot is, as you know, a much more effectual means of destruction and penetration than mere weight; double weight of shot has double penetrating power; double speed of shot has fourfold penetrating power. The larger bore has, therefore, the great advantage of giving higher speed of shot and greater penetrating power.

Double weight gives double destruction.

Double speed gives fourfold destruction.

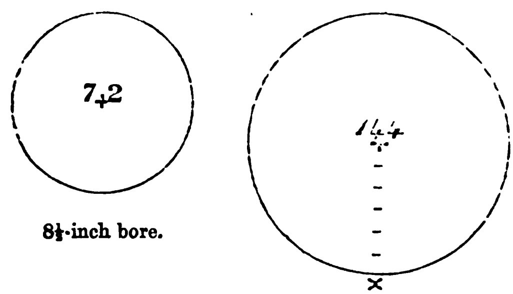
The next element of efficiency is the power of the hollow shot as

an explosive shell. I need not prove that with the same weight of piercing shell, the larger bore admits of much larger explosive effect of the shell.

Thus, then, in all these ways, viz., greater initial speed, greater destroying power, greater explosive effect, the large bore 12-ton gun is more effectual for naval use than the smaller bore.

FIG. 1.

Powder Power. Powder Power.



8½-inch bore.

12-inch bore.

So much for the power of the larger gun for more work. Next for its own power of endurance.

I now proceed to show how, by wise arrangement, this larger bore gun of 12 tons may have more endurance than the small bore gun also of twelve tons.

I shall be told at once, that it is quite true that my large bore has greater propelling power on the shot than my small bore, but that the powder in my large bore has greater bursting power on the gun-barrel than in the small bore. This is quite true, but it is true in quite different proportions. The *propelling* power is as 72 to 144. The *bursting* power is as 102 to 144. This gives a clear balance in favour of the large bore of 144 to 102, or of 42 per cent. gain.

Propelling powers 72 to 144.
Bursting powers 102 to 144.

But I shall next be told, that my larger bore of given weight, must be thinner than the small bore of equal weight, and therefore weaker. I will show that it is thinner, but *little* thinner, and that this thinness has as compensation a better distribution of material to stand the strain, and that the balance on the whole is in favour of the large bore.

Taking then, say an 8-inch gun, as simpler for comparison than an 8½ inches, an 8-inch twelve-ton gun would be 12 inches thick, a 12-inch gun would be 10½ inches thick, or a loss of thickness of 21 to 24, but the better distribution of strength is as 13 to 9, or as 26 to 18. Combining these proportions, we find the gain in efficiency to do more than compensate the loss in thickness; the resulting gain being as 54 to 43. See Figs. 4 and 5.

Summing up the result, the larger bore is the more lasting gun.

Thinner metal . . . . 21 to 24 } Gain 54 to 43.
More effective distribution 26 to 18 }

The next question is Mode of Rifling. On this I have merely to say, that I have always been the consistent advocate of an accelerating twist for small-bore guns with common powder-charges. But for large guns with new and well regulated powder-charge, I am of the opposite opinion. For large guns, with regulated powder-charge, we must lay aside accelerating twist and come to uniform twist.

My reasons are two; first, accelerating twist injures large guns; second, it is rendered quite unnecessary with a regulated powder charge. [Third, with a regulated powder charge and uniform twist we greatly increase the safety of the gun and the safety of the shell.]

To satisfy you of the correctness of my conclusion, I must first allude to the action of a common, or as I call it, an "unregulated" powder-charge. Take a bagful of gunpowder and stuff it into the chamber of a gun in the common old fashion, and what do we get? A sudden, instantaneous, violent shock of bursting explosion. This is just what we do not want. It weakens, if it cannot burst the gun. But what is worse, it does not move the shot forward, except through a small portion of the gun. Next it falls off and ceases to drive on the shot when we most want it. It does least good with most harm. This I call an unregulated or destructive powder charge. Some people call this quick-burning powder, and think they cure the evil when they give us slower burning powder. But if they merely do this, they cure one ill and make another.

What we want, is not slow-burning powder, nor quick-burning powder; but a powder-charge that will burn quick when we want it quick, and slow when we want it slow. Or what I call a regulated charge.

Let us then consider how a powder-charge ought to do its work for us, so that it will get the most useful work done by the gun with the least harm to the gun itself.

The answer is simple, clear, and absolute. If you want to give 1660 feet per second speed to your shot at the gun's mouth, with least strain on your gun, you should drive it as follows. I use the word "*instant*" for $\frac{1}{1000}$ of a second of time, and I express the movement of the shot in inch-lengths of travel along the barrel.

	1st.	2nd.	3rd.	4th.	5th.	6th.	7th.	8th.	9th.	10th.
Instants of time	·001″	·001″	·001″	·001″	·001″	·001″	·001″	·001″	·001″	·001″
Movement of shot ..	1 in.	3 ins.	5 ins.	7 ins.	9 ins.	11ins.	13ins.	15ins.	17ins.	19ins.
Travel of shot	1	4	9	16	25	35	49	64	81	100

Thus we see, first, that the travel of the shot begins slow, grows fast, and ends quick. If then we wish the powder to do its work with least pressure and no waste, the powder must fill the space behind the shot with steady force, in quantity, as it is wanted.

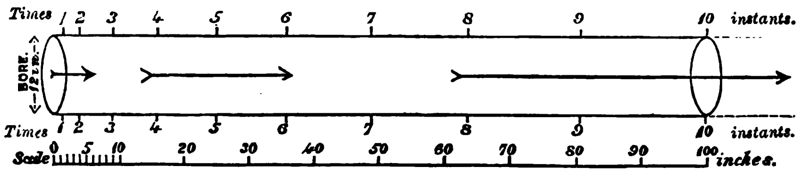
How is it wanted to burn? Thus, in the first instant, say 1 ounce

will fill the space with the uniform pressure wanted to move the ball one inch. If so, 3 ounces will have to be burnt to fill up the additional 3 inches behind the shot with the same pressure. In the third instant 5 ounces must be burnt to fill up the 5 inches of path of projectile, and so we see that the powder-power ought to be so developed as to burn very slowly at first and very quickly at the end, growing as the shot goes.

In other words, you want slow burning of powder at first, gradually growing quicker and quickest at last!

Fig. 2.

Bore of 12-inch gun, showing place of shot-base at each instant acquiring speed of 1660 feet per second.



Now, if you can get that done, your guns will last longer than they have ever done, your shot will go further, and faster, and steadier than they have ever done, and your whole work will be better done than ever.

We now meet face to face the next question, have we got such regulated powder-charges as I speak of? The answer is no, very much the reverse; then the next question is, can we get them?

I answer, "say you wish it," and you will get it. Plenty of clever men will give it you if you unanimously and strongly will it.

Of course, I see how I can do it, or I should not, as a practical man, recommend you to do it. I will show you two ways to do it.

First, in order to regulate your powder-power in great guns, you must take trouble. The same trouble we take in our guns for grouse-shooting and deer-stalking. You must get proper cartridges, skilfully prepared beforehand, and carefully stored ready for use. I recommend you, for great guns, metal cartridges, such as you have for little guns. Get these metal cartridges carefully, wisely, exactly made. If you choose to do that, you can control your powder-power in a manner absolutely certain and absolutely safe, and you can make it discharge itself exactly as you wish.

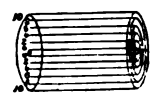
Take this (diagram Fig. 3) as your cartridge, sixteen inches long and a foot in diameter. Pack that up in a metal case, and if I had anything to do with it I would solder it up (not hot solder of course), and make it absolutely air and water tight. The cartridge should be built up in hollow cylinders of gunpowder, just as you would build a gun, those cylinders of gunpowder being made as solid as you make your pebble powder, or more solid if you like; then fill the entire of the cartridge with condensed powder so arranged that combustion should take place from the centre. Now you know, on a small scale, we have what is called central fire, but on a large scale we have never yet perhaps thought of it. But what I say to you is this, that I have

mathematically ascertained, and practically proved, that if you will bore that hole in the centre of a solid cylindrical cartridge, and burn that from the centre, then you will see that the area exposed to the flame in the process of combustion will burn your cylinder in this manner: it begins burning there (diagram), and in the first period you will only have the inch round in the act of burning, but when the inch has burnt off observe the hole becomes two inches round, and the cylinders expose larger and larger surfaces to combustion as the process of combustion goes on. The result is this, that the size of those surfaces in these built-up cartridges increases in precisely the ratio of these numbers I have shown you.

Diagram of Concentric Cylindric Cartridge.

FIG. 3.

Regulated 12-inch cartridge producing maximum speed of shot with minimum strain of gun.



You will now see that common powder cartridges and even pebble-powder cartridges, have exactly the opposite qualities of these regulated ones. They inevitably burn quickest when we want them slowest, and slowest when we want them quickest.

The diagram shows you how we can have the powder-power developed exactly in the proportion, speed, and strength we want. As to quality of powder or other explosive matter, we choose it as we want, and the cartridge regulates it to suit our work.

Now that we have got a powder-cartridge of regulated power, our difficulty about rifling disappears. The uniform twist gives all we want. The acceleration of the revolution of the shot goes forward exactly with the same uniformity as the acceleration of the shot, and so all we want is attained; the pressure on the shot both ways is perfectly uniform, and so is the acceleration, and both with the least wear and tear, both of gun and of shell.

The next point, I have not yet touched upon, is perhaps the most important for you to decide. Do you prefer having to load your 12-ton gun from the muzzle or the breech? You, not I, must decide.

All I can do to aid you, is to tell you what I know. I know that a breech-loader is not weaker than a muzzle-loader—properly made, rightly proportioned and wisely used. I quite admit that a breech-loader requires a wiser man to design it and a cleverer man to use it. But I need not tell you also that a fast ship requires a cleverer man to handle it than a slow one! The better weapon deserves and should have the better man.

Believing then, as I have long done, in breech-loading, I can only entreat you to adopt it at once and without delay. Do not let our past blunders discourage you. Let us at once frankly admit, that we were unwisely committed to a bad system of breech-loading. That

we wisely gave it up. But now that universal experience shows the advantage of a wiser system, let us candidly confess our blunder, and substitute a wise system of breech-loading for our large-bore naval-gun.

Now I will not dogmatise about systems of breech-loading. Of the French system for large guns, I have seen much and studied it for many years. I prefer it to the German system for naval large-bore guns. Sir Joseph Whitworth's system has many of the merits of the French system with some of its own. But of that you are the judges, not I.

As I have spoken of the cartridge and of the mode of charging the gun, I may say a word on the shell for our 12-inch 12-ton gun. By our 12-inch bore we can get a magnificent explosive shell. With our uniform twist of rifling we get rid of studded shot with their dangers and inconveniences, on our large scale. With uniform twist, we can get a long, smooth, perfectly fitting bearing between our barrel and our shot, in the lands or on the ribs, as we prefer.

What I have to say about the shot for our purpose, that is, for naval shells against armour-protected ships, at moderate range, is shortly this: I do not find the rounded point, or oval or parabolic form the best; I know that a conical-ended shell is stronger and better suited for penetration and destruction than any other form. I do not say that an oval point or parabolic is not the best form of shot for long range flight. I do not say that a cylindric point, like Whitworth's, is not the most perfect instrument for penetration; but even Whitworth gives his flat point a cone to some extent. What I say is, that for an explosive naval shell, conic ends are best for strength.

I have still to add something on the structure of gun and the best material for our 12-ton 12-inch naval weapon.

1. My opinion is very strongly in favour of having your great gun very nearly all in one piece. I do not think a great gun, made up of many pieces, is reliable. It seems to me to resemble *patchwork*. If you bring too much strain on one of its pieces, the piece flies and the gun is lost. If I cannot have it all in one, then I should make this condition, that the inside tube should be all in one piece, and the outer tube or cylinder also all in one piece, each containing, and reinforcing, and so helping the other. After that the fewer patches the better.

As to the material of which our naval gun should be made, there need now be no doubt. Steel and iron can now be made of any required quality, and nearly any quantity in one piece. I know that the 12-ton 12-inch gun, we have been discussing, can be made of Whitworth's condensed, tough, powerful steel, in two concentric tubes or cylinders, an outer and an inner tube. I dare say that our engineers at Woolwich will be able to make you the outer body of that gun in one piece of wrought iron, with an inner single tube of Frith's steel. By-and-bye, if you desire it, the gun may be one whole; but at present I prefer to have it in two layers, outer and inner, but each extending the whole length and not in patches.

In regard to the material of the shell, I must leave it to the result of your own experiments to decide whether for actual engagement with an enemy, you ought not to have the *very best steel* shells for

effective penetration and for security from premature explosion. Cheaper shells might be good enough for practice, but I consider that when you come within short range of your enemy, there is no shell, however costly, that should be reckoned "too good" for him. In short the most effective would be really the cheapest.

In regard to gunnery and gun-carriages, I think that when you have resolved to adopt breech-loading, matters are simplified very much. I think the existing naval gun-carriage as designed by Captain Scott, R.N., is an extremely good one; I also am of opinion that for certain special ships of war, the gun-carriage of Major Moncreiff, offers very important advantages in use, and facilities in application.

But the most important of all gun-carriages is the ship herself which carries the great guns we are now discussing. Unless the ship herself possess all the qualities of a handy, quick, steady, secure, gun-carriage, nothing we can put on board of her will enable her to win a battle at sea. My own opinion is quite made up as to the qualities our ships should have as gun-carriages, and how these qualities should be gained. But that subject is too large for this occasion.

What I should desire you, the sailors and artillerists of this meeting, to agree with me in, is especially the narrow question, what is wanted for our standard naval gun? and I should wish you to confirm me, or correct me as to the following conclusions:—

For the Standard Naval Gun.

Is 12-tons a manageable weight?

Is 12-inch bore a good size for a naval shell?

Is uniform twist in large-bore-rifling to be preferred?

Is regulated production of powder-power expedient?

Is a built up uniformly accelerating cartridge practicable?

Is continuous-groove-rifling better then studs in large shells?

Is it to be desired that the strongest, toughest steel be used, both for guns and for shot and shell?

Should the 12-ton 12-inch gun, be made in only two cylindric tubes?

Should simple practical breech-loading be adopted?

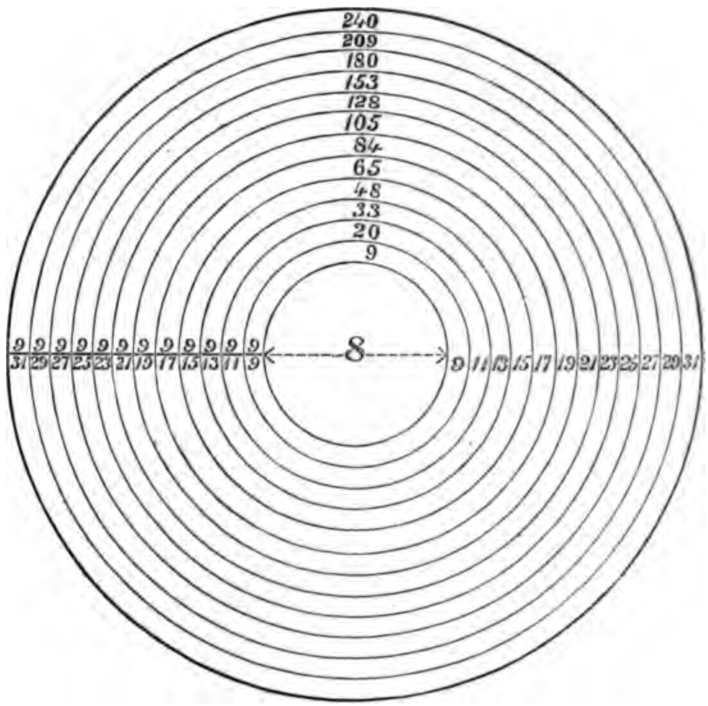
Are the existing naval carriages efficient?

My attention has been called to an omission that I have made. These figures represent one of these difficulties which I have omitted to allude to in the making of heavy guns. I did intend to have introduced that subject at the end of this lecture, but it was already too long. Some of my naval friends said to me in coming here, "You are confining yourself to a 12-inch gun and a "12-ton gun, why not have a 24-ton gun, and a 36-ton gun, and a "48-ton gun," and so on. I have investigated the whole of that subject, and let me tell you that there are great disadvantages in very heavy and thick guns, which are all explained for you in the accompanying table.

FIG. 4.—8-INCH 12-TON GUN, 12 IN. THICK.

Weight increasing with thickness.

Strain on each layer.



Stuff in each layer.

FIG. 5.—12-INCH 12-TON GUN, $10\frac{3}{4}$ IN. THICK.

Weight growing with thickness.

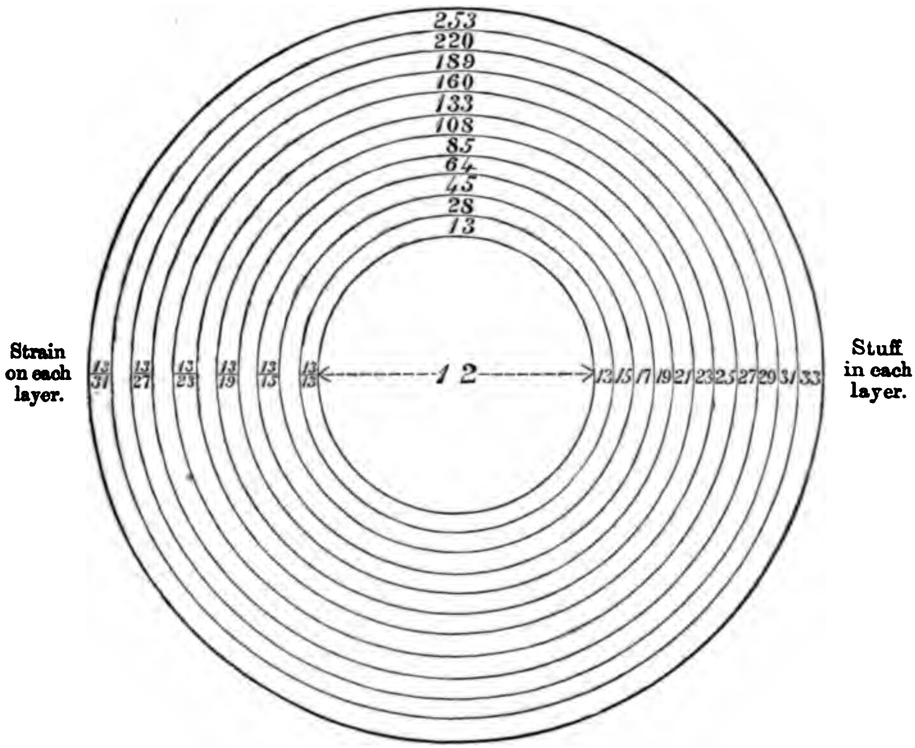


Fig. 6.

Cwts.	Tons.	Weights of each successive thickness.		Efficiency of each successive thickness.
108	5·4	108	13 × 1·000 15 × 0·866 17 × 0·764 19 × 0·684 21 × 0·618 23 × 0·564	·749.
288	14·4	180	25 × 0·520 27 × 0·471 29 × 0·448 31 × 0·418 33 × 0·393 35 × 0·360	·435.
540	27·0	252	37 × 0·341 39 × 0·322 41 × 0·317 43 × 0·302 45 × 0·288 47 × 0·276	·309.
864	43·2	324	49 × 0·265 51 × 0·255 53 × 0·244 55 × 0·236 57 × 0·227 59 × 0·219	·241.
1260 Total weights.	63·0 Total weights.	396	61 × 0·213 63 × 0·205 65 × 0·199 67 × 0·193 69 × 0·187 71 × 0·183	·196.

The explanations in this table show you how round your 12-inch gun you could put coating after coating, thickening it all the way, until you made it up, as I have done here, to a 63-ton gun—I believe, in fact, you are making an 80-ton gun. This being the radius of the gun, I call your attention to this important point. The first coating on the skin of the gun does its full work, say a coating an inch thick of iron or steel; and, therefore, out of the first inch of the gun I get the full per centage of its work—a hundred per cent. we will say. The first inch thick of the gun would weigh 13 cwt., and that 13 cwt. would do its full work, or 100 per cent. The next coating would weigh 15 cwt. more, now we have the gun two inches thick, and it would only do 86 per cent. of the work the first inch did. The next one would weigh 17 cwt., and only does 68 per cent. of the work; and as you grow in the thickness of your gun we have now got 108 cwt. in the first six inches, but mind, the average per centage that that is doing of useful work is only 75. If you say make this gun six inches thicker you add 180 cwt. to the weight we had before, and this 180 cwt. does diminished work, the sum total being only 43 per cent. of useful work. Now go on and add six inches more, there is the weight of each of the layers an inch thick, and I add 252 cwt. more to the gun, and with this 252 cwt. I only get 30·9, that is about 31 per cent. of useful work. With the next six inches I add 324 cwt. to the weight of the gun, and only get 24·1 per cent. of work out of

the whole of that, and if you insist on it I will go six inches more, but I am tired now, and I hope you are; 396 cwt. I have added to the gun, and the per centage of useful work out of that 396 cwt. is only 19·6. Now what have you got? You have got a gun which began with 5·4 tons, which you then raised to 14·4, then to 27 tons, then to 43 tons, then to 63 tons total weight; and every ton you added became of less and less useful value as you added it. That is the reason why I do not recommend to you guns of excessive weight; and when in the future you hear of a great gun of enormous weight, will you please keep in your memory this column of diminishing efficiency? If you want a good gun, you must make a large bore to lighten the pressure upon it, that will give endurance to your guns, and then you must use the metal in a moderate quantity instead of an excessive quantity; you will then get a much higher duty out of the metal, but the way of doing that is to select with infinite care the qualities of your metal. Do not let the word "steel" touch your minds; do not let the word "iron" touch your minds; do not let the word "alloy" have anything to do with it. Every one of us has his crotchet (I know I have mine), take the most perfect metal of the largest strength, of the greatest toughness, of the utmost reliability, in the right masses, and in right shape to be an enduring gun, and do not trust to mere bigness, it is a fallacy.

Captain R. A. E. Scott, R.N.: To grasp all that Mr. Scott Russell has said is exceedingly difficult, but still I think I can corroborate in some measure a few of his points. The endurance of one or two of the Palliser lined guns has heretofore been a matter to me of very great surprise. The wrought iron tubes of these guns we put *slackly* into their reamed out cast iron envelopes; hence it is evident that the cast iron can give but little support to the tube inside it; and yet, strange to say, one of these Palliser lined guns showed greater endurance than one of the wrought 64-pounders, built up as these guns are at the present time with a great mass of coiled metal at the breech. Without fully accepting the figures given, I think this experiment shows that there is a great deal of truth in them. Again, most of you are aware that one of the earlier 600-pounders burst after a few rounds. It seemed to have split coil after coil throughout its thickness, indicating, as it seems to me, that the coils do not act in unison on a sudden shock, and hence that the sum of strength of the superposed layers of coils represents far more than the actual strength of the gun. If you compare the Palliser lined gun, and our own wrought iron gun, it seems clear that if the inner tube in the one case ought to be put in slack, it ought to be put in slack in the other, whereas in our built up guns the inner tube, and likewise all the coils over it except the outer one, is subjected to very great compression in order to bring the other parts of the gun into play to resist the violent shock of discharge. In fact, the built up coil gun is in a state like a very tight string, and hence a sharp blow is likely to cause its destruction. I think one of the guns which broke in pieces was burst very much in this way. I do think our guns are not of the right shape—they are a great deal too thick at the breech, and too thin at the muzzle, especially for the present slow burning powder. We could afford to take off a large quantity of metal from their breech. What Mr. Scott Russell says as to a gun being made of two layers only, viz., an inner tube and an outer one, I believe to be very nearly correct. I do not think you want many layers of metal, but what you do want, is the very best metal, especially for the inner tubes of our guns. The best metal I know of at the present time, but it has not yet been produced in large quantities, and is consequently very expensive, is Sir Joseph Whitworth's fluid compressed steel. The whole question as to the best naval gun and projectile is of the utmost importance to us.

Captain Colomb told us in this Institution, and with truth, that the power of the guns was receding as compared with the size of our ships, and, doubtless, as we are lessening the number of guns, and increasing the thickness of armour, we are really obtaining defensive mail at the cost of gun power. I do not mean to say that the introduction of a few large guns rather than numerous small guns is wrong, but I wish to bring out this point, that in proportion as fewer guns are carried, accuracy is of more vital importance. Not only must there be accuracy, but when the shot strikes there must be a certainty of penetration, but that certainty of penetration does not at present exist. The studded shot are very brittle, the largest being first wounded with thirty-six holes in their sides, and then having thirty-six buttons stuffed into these holes under powerful hydraulic pressure. The consequence is, if you give these shot a hard tap, or even subject them to sudden changes of temperature, they are liable to split, and as a matter of fact, we have had numbers of such accidents with studded shot. Returning to the question of the very few guns some of our armour-clads are carrying, I would observe that an armour-clad is not so fast as any unarmoured ship, and unless the ironclad has efficient artillery, an unarmoured ship may keep ahead of and spot her as she is either rolling or pitching deeply, or rising with her forefoot nearly out of the water, and thus leaving a very large unarmoured surface exposed, and which could be hit very easily. We have not as yet nearly attained to the accuracy which we shall hereafter attain, and which we ought to have long since reached. Another point in this important matter is, that our experiments have been hitherto made in firing at plates placed at right angles. In a naval action, however, the shot will very seldom strike at right angles, but almost always at a very acute angle, so that judging from our experiments, it seems to me that the present weak projectiles will produce a very small effect indeed upon an enemy. For the Navy, therefore, it is most important that we should have in lieu of such untrustworthy missiles the very strongest projectiles (punches) that can be manufactured. Hitherto there has been no attempt to carry out a series of practical experiments, and there has been no real competition with heavy guns; I speak this advisedly, for in the so-called seven-inch competition there were no live shell fired, there was not a single shot fired against an armour plate, there was no test of the endurance of the guns, nor was there any practical test whatever, and hence it is not surprising that the gun selected, viz., the French gun, very soon afterwards split through its inner tube. Any one may see at a glance what must be the effect of rotating a shot by means of studs, and why our guns have a very small endurance; in fact, these stud bearings do not even stop the rush of gas past the shot, and hence the gun becomes rapidly eroded in its inner tube; the shot also, from not being held firmly by these weak studs, strikes against the bore, and thus very soon succeeds in cracking the inner tube of the gun. The 35-ton gun had to be re-tubed after a very few rounds; it then fired a few more, and was turned over and re-vented, and I believe at the present time it is in rather a shaky state. This lack of endurance is not what we require for a naval gun. It is of immense importance that those who have to sail in our war ships should have guns that will not only enable them to fight one action, but that will have sufficient endurance to enable them, especially when on foreign stations, to fight continuously. In war, a gun may have to fire a very great number of rounds before the ship carrying it can go to a dockyard or arsenal; and it is of vital consequence to the Navy that its guns should not deteriorate so very rapidly as they now do. The worst of any deterioration is, that the action of the studs on the damaged parts tends to dig little pits in the inner tube, so that besides the weakness ensuing from deterioration, there is another element of danger from the hanging (or detention) of the shot in the bore. Even were there no obstruction in the gun, the shot, if it cracked, would naturally break through its weak part, the stud-holes, which are just opposite the rifling, and damage the grooves; and, as a necessary consequence, you could not load your gun. One bad effect of our present experiments is, that no man commanding a ship knows at what angle his shot will penetrate an enemy. I believe that the 64-pounder (the gun chiefly used afloat), stud projectile, would break up harmlessly if it struck obliquely against an unarmoured ship's side; but we have had no experiments to test this, or to test the relative power of penetration of our different shell. Instead of continuing in this dangerous

groove of ignorance, we urgently want, at the present time, a full inquiry extending over the whole subject of Naval Armaments; and there is this important collateral question in relation to it, whether we have not gone on loading our ships with armour without due reference to other requirements. In what position do we now stand? The ram is well nigh useless, because the torpedo keeps its use in check, and hence the gun is more important than ever to us. What we now need is a careful consideration of all these points, and a trial with say a hundred rounds of the best projectile made of one metal only, to be tested against the system which has been built up upon no solid foundation. In such a trial, the value of each point should be first settled, and then the shot fired for accuracy, might also be made to test the endurance of the gun, as well as ease of loading, strength of projectile and every other requisite for a naval gun. Angular firing against an armour-plate is an experiment so simple and so little costly, that I should be very happy to try the long bearings—that I have advocated—at my own cost. Then you may say that any change in the manufacture of projectiles, &c., would be very costly, but it really is not so. Mr. Scott Russell has shown you the great thickness of the main tubes of our guns. I believe their thickness is beyond what is necessary; and, therefore, it would be a very simple process to re-rifle the guns for the Navy, and to use the Navy ordnance and projectiles we now have in shore batteries. At present we must do something to increase the endurance of the guns, and hence are obliged to fasten on to the rear of our projectiles a large lump of brass called a wad. This wad will not, however, stick on, unless the shot are expressly cast for it, so that we must, in any case, provide new shot for the Navy. As for the big guns of 25 and 35 tons, they are of the same 12-inch bore, but they will not fire the same projectiles, one having a much sharper rifle-twist than the other; the 38-ton gun has a still sharper twist, and also a larger, viz., a 12·5 inch bore; therefore, there are three heavy guns very nearly alike, and neither of them able to take the same projectile. This useless multiplication of projectiles is a very serious evil. What Mr. Scott Russell says of the powder cartridges is, I think, practicable, and I am very much inclined towards the breech-loading apart from the question of the rifling. I think some years ago we accepted muzzle-loading, and have since held to it on account of its simplicity; but now that we have gone into such large guns as to necessitate hydraulic loading, and hence got an arrangement very liable to damage (for a valve going wrong would put the gun *hors de combat*), I think we can very well afford to go into breech-loading, which is comparatively simple. As these questions concern the future of our Navy, I can see no valid reason why there should not be a thorough and exhaustive inquiry that should look a little outside the official groove we have at present got into. One word more as to our ships; I have hesitated a good deal as to saying it, but I think I may venture to assert, by our belief that we have been piling on armour with the idea that our ships are always to be hit at right angles, that the great weight now carried in armour would have been much more efficiently used if it had been carried as guns, coals, and the other requisites needed by a war steamer. I believe our very heavily armoured ships are a great mistake; and, looking at their large area of vulnerability, I think that if two smaller unarmoured ships were to attack one such armoured ship on either bow, and to fire at her both when she lifts to the sea, and when she pitches bows into it, that the ironclad would run a very poor chance indeed.

Admiral Sir Henry Codrington, K.C.B.: The lecturer seemed to be under a mistake in thinking that this meeting should pass a vote. We are here as members of this society free to entertain our individual opinions, but we do not vote. Nor could we give an effective expression of opinion. It would be contrary to the rules of the Institution. There are, however, one or two points I wish to ask about. Is the rear of that cartridge to be open?

Mr. Scott Russell: No, closed, fired by concussion through the closed rear; no combustion behind.

Sir H. Codrington: I wish to ask upon what do you base the calculation—it seems a very good one—of the time and distance of the shot going on in its passage out of the gun.

Mr. Scott Russell: On absolute mechanical principles; I undertake to demonstrate by physical or mathematical demonstration that that is the method

which unites the greatest velocity with the least strain. Permit me to say also it is the same law as that of accelerating gravitation; the same law as that of the steam engine or of any other propelling power.

Sir H. CODRINGTON: I think, in advocating the larger diameter of 12 inches, there is one thing lost sight of. You say there is greater initial velocity in the proportion of 144 to 72. What is the velocity at 2,600 yards distance? that would be the point; because, after all, it is not always the velocity at which the projectile leaves the gun, but the velocity at which it strikes the object. If that large diameter meeting the resistance of the air is slackened in its speed considerably, then the small diameter, though starting at less initial velocity, may be actually striking the heavier blow. Am I to understand that there is a different amount of powder in the 8½-inch gun, or is it the same amount of powder?

Mr. SCOTT RUSSELL: Which way you please. If you wish this (the 12-inch) to exert the greater power, you put in more powder.

Sir H. CODRINGTON: It is not the same?

Mr. SCOTT RUSSELL: Not the same powder-power.

Sir H. CODRINGTON: I presume, also, that the more elongated shot will have the steadier flight, and particularly at a distance.

Mr. SCOTT RUSSELL: Quite true.

Sir H. CODRINGTON: Consequently, it would have more penetration and more accuracy. I should be against entirely arming a ship with guns of the larger diameter, though I fully agree with their advantages. I would rather have a chase gun, because there is another thing we have to do—not only to fight our best when within 1,000 yards, but also for distance firing when in chase, and to bombard fortifications, &c., at a distance, where we want extreme flight with a very fair allowance of accuracy, which the other would not give.

Mr. SCOTT RUSSELL: I am very pleased to answer these questions, for they simply supply omissions. In the first place, to both these shot I can give 1,660 feet velocity. That somewhat answers the question, because, with 1,660 feet initial velocity, you are able to get all you want for an ordinary naval gun; but I quite agree that the larger shot, if the velocities are equal, will encounter the greater resistance; and, therefore, I was not satisfied, any more than you may be, with being able merely to propel this larger diameter of shot; and I found out that there were laws well known to other countries, if not by us, by which (and this I must ask you to grant for the present without discussion) a shot of small diameter, a rifle shot of small bore, is capable of being fired out of a gun of larger bore with the same precision and with much higher initial velocity than out of its own gun. Therefore, permit me to say that one of my reasons for confidently recommending to you to choose the 12-ton gun is this:—that I will take the shot of the 8-inch gun, that I will put it into the 12-inch gun and will send it out for you with higher velocity, due to its higher propelling power, and with the same precision. That is a serious question, which, if you choose, we will discuss another night; but I undertake that you will, and but for that I should not have recommended it to you. I am entirely of the Admiral's opinion that, while we might choose to take a gun of this weight for the ordinary broadside armament of a ship, I should go back to our nice old-fashioned custom of having a *good long chase gun* in the bow, provided I had found that that good long chase gun would give me the qualities for practical purposes that this shorter gun would not, but in that case I should not diminish the bore of the gun. I should keep the same bore, and should only do as we did in old times. My pet gun was the 65-cwt. 8-inch gun, but the 95-cwt. 8-inch gun was the gun we put in the bow of the ship, and, therefore, if you find that our 12-ton gun of 12-inch bore, which is probably 14 feet long, is not all you could wish for for the bow gun—I think it may be more even than you expect—but, if you find it is not all you could wish, no man would more energetically go with you in the desire to make the bow chase gun, a 12-inch gun, but a heavier gun, with a longer range and greater precision for exceptional purposes. And, if you please, let us talk of the 12-ton 12-inch gun as *the ordinary standard naval gun*, and then let us also have *exceptional guns* for exceptional purposes. I think that reconciles all differences; but, take my word for it, you can fire the small bore shot with perfect precision and far greater velocity out of the big bore gun.

Sir HENRY CODRINGTON: There is another point about the penetration of a shot of a diameter of 12 inches compared with the penetration of a shot of the diameter of 8½ inches. I have always understood that 8½ inches would have the greater penetration, weight for weight, and velocity.

Mr. SCOTT RUSSELL: I perfectly agree, as to the greater penetration of the smaller shot, and that is why I am so pleased to be able to tell you that your elongated smaller shot, when you wish that peculiar kind of work, can be fired out of that same 12-inch gun at the higher velocity. I think that gets over the difficulty. Do you not think it does?

Sir H. CODRINGTON: I think it does.

Captain HORTON, R.N.: May I ask Mr. Scott Russell whether that practice of firing the smaller projectile out of the larger bore involves breech-loading, or whether it is practicable from the muzzle also?

Mr. SCOTT RUSSELL: I have only seen it practised with breech-loading, but I cannot see the difficulty. The shot I am acquainted with is one which I see no great difficulty in putting in to a muzzle-loader than any other. You will understand it in a moment when I say the lifting would be identical in the two cases.

Sir H. CODRINGTON: Would there be no oscillation of the smaller projectile, and no deterioration of the gun?

Mr. SCOTT RUSSELL: None whatever.

Mr. MACOMBER: I should like to make an observation or two in relation to Mr. Scott Russell's paper, to which I have listened with very great interest. I only wish to ask a question or two, leaving it for him, if he pleases, at any time, to settle it. What is the difference between the strain of the inner part and the outer part of the breech of a gun? The demonstration made by the gentleman is most excellent. We know that it diminishes, but the question of the proportion of such diminution does not seem to be settled. One other thing I wish to ask. Supposing there was a method by which the strain upon the gun could be entirely equalized, so that the strain should go upon all the outer metal in the same proportion in the same instant of time that it does upon the inner, would, or would not, that be an advantage? Again, would it not get rid of all that extra metal which is so admirably shown by Mr. Russell, and is so well understood, and would it not, under those circumstances, be an advantage by which we should be able to use less metal and still retain greater strength?

Mr. SCOTT RUSSELL: I think the speaker and I are entirely at one. I think if you could obtain a method by which you could turn the strain of the outer coating, utilize, I call it, the strength of the outer coating as completely as you do the strength of the inner coating, you get a manifest gain; but I suppose the speaker, who is well known as a gun-maker, knows very well that we have tried a good many experiments in this country on that subject, which have not been very successful. I think some of our most famous gun-makers put the outside of their gun into an extreme state of strain, and in such a manner that they believed that they had so adjusted it that the strain which was already put on the outer one relieved the inner one in such a manner that when the inner one was strained, they came, in the end, to exactly the same state of tension. Of course, if that were done, I admit that that is an advantage, because a thinner gun endures a much higher strain, and there is much less likelihood of the rapid destruction of the gun; but in the peculiar expedients that we adopted in this country—and some of our cleverest men adopted them—there was admitted one element, the element of time. It was discovered about twenty years ago, by a very great man at Manchester, called Mr. Hodgkinson, that time has a wonderful effect in changing the condition of matter under strain; and so it was proved that those people who had put the coats of their gun into an artificial state of tension for the very object mentioned by Mr. Macomber, made very good guns the first day, but which were less and less perfect every other day. It just reminds me of a man who had a great establishment in London, in which he could make the most magnificent wines anybody ever tasted, of the oldest vintages. They were perfect wines the first day; they were not so good the second day; they were bad the third day; a great deal worse the fourth day, and so on—and that is the state of guns put for this wise purpose into artificial tension, and so that has been given up. Whether there is a substitute for it I do not yet know. The only sub-

stitute I know is, to select the outer coating of the gun with one peculiar quality of tension, and the inner coat of the gun with another peculiar quality of tension, so that when the strain comes on them, the tension in each shall rise to the proper proportion on the ultimate strength of that metal. By a wise choice of the inner and outer metals, I think what Mr. Macomber says could be secured.

Mr. MACOMBER: I may be excused for another observation. I have been mentioned as a gun-builder, and therefore I must own that I have built guns; and in relation to the last observation with one gun[1] that I made, we had an initial velocity of over 2,000 feet per second, and I fired the gun myself 288 times, and after the last shot, upon examining the gun with the best instrument I could find, there was not the least change whatever in the diameter of the bore or the chase. One other observation is simply this:—I should have been very foolish to have asked the question if I could not in my own way have answered it to my own satisfaction, although not perhaps to the satisfaction of others. It is, that there is a method by which when a gun is being built, if I may be allowed that expression, you may strain that gun to a greater extent than subsequently it will ever be called upon to endure, and that, therefore, such a gun, if it does not deteriorate in the quality of the metal, would certainly stand that strain, and a great deal more; how much I do not know. The present gun that I have, has been fired with an initial velocity of over 2,000 feet per second. It is not a large gun. I should like to ask Mr. Scott Russell to give us the proportion of powder that he would use in proportion to the weight of shot, which, after all, is a very serious question, for out of a small amount of propelling power, whatever it may be, gun cotton, or anything else, you cannot get a very large effect of power, and if you have a large amount of power you may endanger the safety of your gun. Then, the next question will be to build your gun so that it may be strong enough to bear all that.

Mr. STIRLING LACON: What was the size of the gun with which you made those experiments?

Mr. MACOMBER: It was a small gun of only 1¾ inch calibre. The weight of the shot is about 3 lbs.; but, at an elevation of 38 degrees, I have thrown a shot 9¼ miles, measured with a Gunter's chain. I do not know that I could do it again. It was not with this gun, but it was with one precisely the same size. The observation made by Mr. Scott Russell is, that in increasing the size, the proportions are not kept thoroughly. I grant it, I know it to be so; and if I could get an initial velocity of 1,800 or 2,000 feet per second out of a large gun, I should get great power most certainly.

Mr. SCOTT RUSSELL: With reference to the charges of powder, I do not think it necessary to deviate much from the present charges, for if I find that this graduated system be adopted, a far higher initial velocity will be attained with a far lower charge. I dare not tell you almost how low a pressure of powder would give this initial velocity in only nine feet length of travel in the gun; and I beg to say I see no impediment in this bore of the gun to raising the 1,660 feet velocity to 1,880 feet; and if Admiral Codrington's long chase gun were added of the same bore, but with greater length, and made of the best possible material, I could undertake for his chase gun that it should give an inititial velocity of 2,000 feet per second.

The CHAIRMAN: I have listened to this conversation with great interest, having been a good deal mixed up with this question of guns some 15 years ago. I have always taken a great interest in it. I still hold myself perfectly free from not admitting of course all that has been stated here. But there is a good deal with which I am inclined to agree. With regard to this 12-ton gun, I remember when I had a 9-ton gun, and mentioned that I was making some 9-ton guns for the Admiralty; and we had also made one or two 12-ton guns, Lord Hardwicke got up and said I must be perfectly mad to be making a 9-ton gun, so that I was obliged to suppress my 12-ton gun altogether. I could not say a word about it. That was the state we were in in 1860 or 1861. Since that, we have certainly advanced with our guns; whether or not we have very much improved is a very different question, and remains to be seen. I think these discussions are very useful, because they do show the differences that exist, and the great variety of opinion; and it is only by

[1] The Macomber gun, see Journal, vol. xix, page 268, *et seq.*

comparing these opinions that we shall eventually get to something very good. This country is no doubt, in point of mechanism, almost the first, or at any rate, one of the first countries in the world, and we have means with regard to metals as great as any other country. But we have not advanced, I am afraid, quite so fast as we might have done in the last 12 or 14 years. I hope, therefore, the attention that is now called to the subject will, eventually, be useful. I do not myself take any particular part either with the Armstrong guns, or with any other guns. Our original breech-loaders we were obliged to abandon. The vent-pieces blew out about our heads, and we were in considerable danger even from the experimental practice. Then we tried the shunt gun, but that has gone; then the hooped gun, that seems to be gone; and, in point of fact, we do not exactly know now where we are with regard to the guns. At any rate I think you will all agree with me in thanking Mr. Scott Russell for having called attention to this subject, and given us a very scientific and a very clever paper upon the question.

LECTURE.

Friday, May 7th, 1875.

ADMIRAL SIR ALEXANDER MILNE, G.C.B., Lord of the Admiralty, in the Chair.

SOME ACCOUNT OF THE OBSERVATIONS RECENTLY MADE BY THE CORPORATION OF THE TRINITY HOUSE ON FOG-SIGNALS.

By Vice-Admiral R. COLLINSON, C.B., Elder Brother of the Trinity House.

IT may, I think, be taken for granted that the object of setting up fog-signals on our shores is generally understood; but in case any one present is not quite clear upon the subject, I will briefly state it to be, to make certain signals by means of sound which will convey to the mariner navigating in the vicinity of land in foggy or thick weather, the same guiding or warning information as that conveyed by means of lighthouses in clear weather.

In the days when our own merchant fleet was not so extensive as now, when steam ships were almost unknown, and when the number of foreign ships visiting our shores was extremely small, the necessity for guarding dangerous localities in foggy weather was not very marked; because vessels, as a matter of fact, generally hove-to if fog or very thick weather came on while they were in the vicinity of land. Here and there on salient points of the coast, with deep water close to, bells were established, but it is more than probable that they were seldom or never practically serviceable.

But as maritime enterprise and discovery progressed, trade and navigation increased in like measure; to this increase the introduction and development of steam power gave a strong impetus, insomuch that the darkness of night ceased to be a hindrance to sea voyaging, and the demand also arose for some sort of guiding signals to enable vessels to continue their courses during fog and thick weather. Thus the question of fog-signals came before those to whom the duty of marking our coasts is entrusted. I allude, of course, to the ancient Corporation of the Trinity House, of which I have the honour to be a member. It is needless for me to bring before you the numerous, and many of them most unpractical propositions which

have from time to time been brought before the Trinity House on the subject of fog-signals. It is sufficient to say that previous to 1872, actual knowledge on the subject was extremely vague, both in regard to the production of suitable sounds and to the actual effect of any such sounds when produced. Varying and often irreconcileable statements were made as to the distances at which sounds of different kinds were audible, but trustworthy evidence on the subject did not seem to exist. The numerous proposals made to the Elder Brethren of the Trinity House were generally characterised by crudeness and insufficient knowledge of what was required; and in accordance with the rule which the Trinity House invariably follow in all matters relating to guiding signals, they were unable to adopt proposals which were based on uncertain foundations, and which gave little promise of being practically serviceable to the mariner. But although definite knowledge in regard to the application of sound for signalling purposes was in so unsatisfactory a condition, the Trinity House always kept in view the ultimate possibility of utilising sound in the manner desired, and as far as they reasonably could (being controlled in matters of expense by the Board of Trade) encouraged inquiry into the subject, and themselves at various times made tentative efforts towards bringing the question into a practical shape. Actuated by such motives, the Elder Brethren gave considerable encouragement to Mr. C. L. Daboll, of New York, the inventor of a fog-horn, sounded with compressed air and worked by means of a caloric engine. Three of these instruments were obtained and set in operation in this country; they have proved of some value, and are working well at this present moment; but as a matter of experience they have never reached the efficiency claimed for the fog-signals in operation on the coasts of the United States and Canada. All sorts of rumours came across the Atlantic as to the distance at which American fog-signals were heard; and as these rumours could only be verified by actual observation, it was deemed advisable by the Trinity Board that a Committee of Elder Brethren should visit the United States and Canada to learn what was the real value of the fog-signals in use in those countries.

Accordingly, this duty was apportioned to the Deputy Master (Sir Frederick Arrow), and Captain Webb, who in the latter part of the year 1872, went out and made a practical examination of many of the signals in use on the American and Canadian seaboards. The report of this Committee contained a great deal of valuable information, described with accuracy the various kinds of instruments used, and showed that the subject of fog-signals had been dealt with on a more extensive scale than in our own country. This latter circumstance is due to the fact that from well known causes fog is very much more prevalent on the North American seaboard than on our own shores, which physical fact, taken in conjunction with the large coasting trade of the country, and the well-known energy of American traders, clearly demonstrates that there is a greater demand for fog-signals with them than with us. The Trinity House Committee, in their report, say:—

"We found that fog-signals were used in the same way as lights "and beacons in fine, clear weather, and are trusted to almost as im- "plicitly. American vessels run by them irrespective of all considera- "tions of crowded navigation, or of other marks. * * * "* * Fog may be said to be the normal condition of the "American coasts for full one half of the year or more; ship masters "and owners cannot afford to be stopped by it, consequently they run "the risk."

But although the investigations of the Committee showed that there was a more extensive system of fog-signals on the other side of the Atlantic, yet they showed also without doubt that as regards the relative value of the various instruments used, and the propagation of sound in different conditions of the atmosphere, as much ignorance prevailed in America as in England; nothing certain seemed to be known on these points, and the reports as to the great efficiency and ranges of fog-signals on those coasts appeared to be founded on evidence of the slightest kind.

The result of the Committee's visit strengthened the desire which the Elder Brethren had long entertained of making a series of comprehensive and exhaustive experiments with the view of gaining more certain knowledge of the subject, in order that in the placing of any such signal, its value for the warning or guidance of mariners, might be more clearly known and understood. The Elder Brethren have always been averse to establishing any guiding signal, the value of which was hypothetical; they consider with their late scientific adviser, Professor Faraday, that "a false promise to the mariner is worse than no "promise at all," and it was this feeling of ignorance and uncertainty about the real value of sound-signals which has for so long a time operated to prevent the more frequent establishment of such signals round our coasts.

On application to the Board of Trade for sanction to the necessary expenditure for the proposed experiments, that department recognizing the national and cosmopolitan value of such an inquiry, at once agreed to allow the necessary expenses from the Mercantile Marine Fund. Although the Elder Brethren generally took an interest in the proposed investigation, the charge of conducting the experiments was confided to a Special Committee, consisting of Captains Drew, (Chairman), Were, Close, Atkins and myself, acting in concert with Dr. Tyndall, the Corporation's scientific adviser; and the Deputy Master was kind enough to spare his private Secretary, Mr. Edwards, to act as Secretary to the Committee, and great use he has proved to us.

The South Foreland was selected, as it offered great advantages for the prosecution of the experiments and for observations being made from sea. The means of judging distances were at hand; the point itself was sufficiently prominent to allow of a large arc for observations; the height of the cliff was advantageous for trying the effect of signals at the sea level and at a considerable elevation; the machinery used for working the electric light could be utilized for working the necessary air-pumps; and access to town was convenient.

It will, I think, be well, first to give a brief description of the instruments experimented with, and afterwards to deal with the observations made and the practical results obtained therefrom.

Instruments Tried.

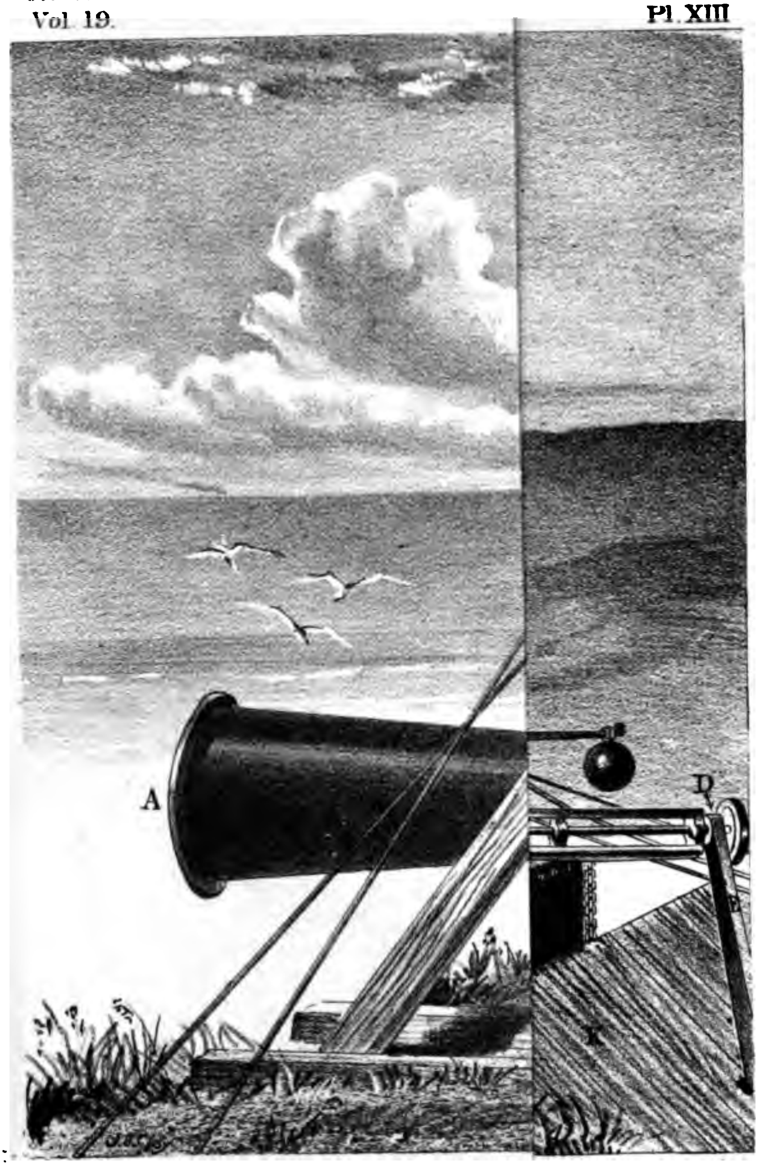
In the experiments, various kinds of instruments were tried, with a view to ascertaining which was the most effective as a sound producer. The instruments set up at the South Foreland at the outset of the inquiry, were English whistles blown by steam and air, and air-horns, or trumpets, made by Mr. Holmes. Subsequently, however, a whistle from America and one from Canada were obtained in order that there might be no doubt as to the best kind of whistles being tried; a steam siren was kindly lent for the purpose by the United States Lighthouse Board, and various pieces of ordnance were, by permission of the War Department, sent on loan from the Artillery depôt at Dover Castle. Of each of these instruments I propose now to give a short description, and to state in what manner they were subjected to trial, leaving the results of the experiments to be dealt with under the head of "Observations."

Whistles.—The whistles are five in number, as follows: Canadian whistle, cast solid, 12 inch diameter, blown by steam, 74 lbs. pressure; American bored and tuned whistle, made of sheet brass soldered to a solid top, 12 inch diameter, blown by steam, 74 lbs. pressure; 12-inch whistle, attached to a boiler, sounded by steam, 74 lbs. pressure, constructed by Mr. Bailey, of Manchester; 8-inch, blown by steam or air, 45 lbs. pressure; 6-inch ditto, sounded by steam, 74 lbs. pressure. The dimensions and adjustments of the whistles are as follows, viz.:—

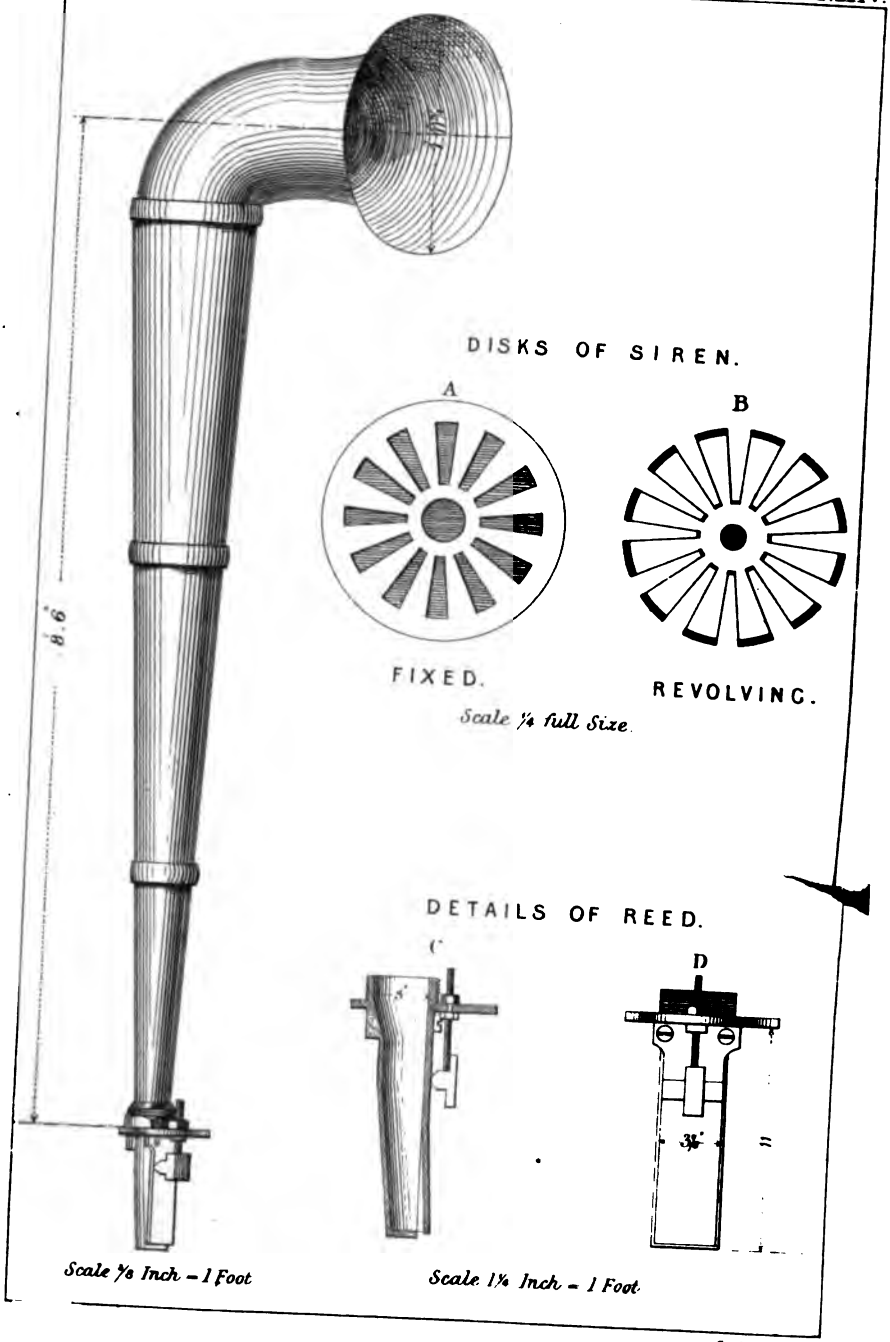
	Diameter.		Length.	Lip to Cup.
Bailey's ..	6 inches	×	8 inches.. ..	$1\frac{1}{2}$ inch.
Holme's ..	8 inches	×	15 inches.. ..	$3\frac{1}{2}$ inches.
Canadian ..	10 inches	×	17 inches.. ..	3 inches.
Bayley's ..	12 inches	×	14 inches.. ..	$2\frac{1}{4}$ inches.
American ..	12 inches	×	20 inches.. ..	$2\frac{1}{2}$ inches.

The distance of the lip from the cup can be varied, with the exception of Bailey's 6- and 12-inch, which do not admit of such variation. It is sufficient to say that with the view of ascertaining the actual effective sound-range of such instruments, and their relative value in comparison with other sound-producers, they were tried alone and in combination; various pressures of air and steam were used in order to discover which gave the best result; the different notes capable of being produced by the whistles were tested with the object of proving which was the most effective; and trial was also made as to whether the sound produced was more effectually transmitted to sea from the sea-shore, or from an elevation 235 feet above the sea-level.

Air-horns, or Trumpets.—I have previously remarked that three of these instruments have been for some years in actual operation on our



A.B. The Siren Trumpet. C. Tha chairen disc.
E. The driving belt. F. ?


DISKS OF SIREN.
A
B
FIXED.
REVOLVING.
Scale ¼ full Size.
DETAILS OF REED.
C
D
Scale ⅞ Inch = 1 Foot
Scale 1¼ Inch = 1 Foot

J Jobbins

coasts, and have been well spoken of by those for whose use they were established; but with the object of gaining more accurate knowledge as to their practical value, it was thought proper to have them tried with the other instruments. The horn is a brass trumpet 8 feet 6 inches long, 3 inches diameter at mouth-piece, opening out to 22½ inches at the other end. The reeds[1] are 10¾ inches long, 3 inches wide, ¼ of an inch thick, sounded by air of 18 lbs. pressure. By means of air-pressure this steel reed is made to vibrate so as to yield a note in unison with the fundamental note of the trumpet itself, the reed having previously been properly adjusted for this purpose. The air-pressure necessary to awake the vibrations of the reed was supplied from two chambers filled with compressed air from air-pumps driven by the steam-engine used for the electric machines at the South Foreland; but in the horns or trumpets now in operation, caloric engines perform the work of filling the air-chambers with compressed air, being more easily and economically worked, and avoiding the danger attendant upon the use of steam. The horns set up at the South Foreland were tested as to their power and range in different conditions of wind and weather; they were tried one against the other, and against other kinds of instruments. Different pressures of air and different notes were tried, as well as high and low elevations above the sea.

The Siren.—This kind of instrument has been in use on the coasts of the United States for some years, and the one tried at the South Foreland was forwarded to England by the authorities in America through the kind intervention of Major Elliot, then Engineer Secretary to the Lighthouse Board of that country. Messrs. Brown, of Progress Works, New York, are the adapters of the siren principle for fog-signal-purposes, and the instrument sent to England was their manufacture. Plate XIII shows the siren and its associated trumpet. For producing the sound, instead of a vibrating reed, two discs are employed, one fixed, the other made to rotate, each disc having, as you see, radial slits exactly corresponding to each other. The fixed disc[2] is fastened across the throat of the trumpet, and the rotating[3] disc is placed before it. Upon this rotating disc a pressure of steam, of about 70 lbs. to the square inch, is forced; and each time that the two discs correspond, a puff of steam goes through the coinciding slits into the trumpet, and a rapid succession of these coincidences produces a rapid succession of blows upon the air in the trumpet, which gives rise to a sound of great power. The most effective rate of rotating the disc is found to be from 2,400 to 2,800 revolutions per minute, and this has to be effected by separate mechanism. The trumpet is of cast iron, and it is not necessary to regulate the rotations of the disc so as to be in unison with the trumpet, as is the case with the vibrating reed and the air-horn; if required, the instrument could be made to sound all the notes in an octave. The siren was tried in reference to its sound-range in various conditions of wind and weather, and in comparison with other instruments; it was sounded at different pressures of

[1] See Plate XIV, figs. C. and D.
[2] See Plate XIV, fig. A. [3] See Plate XIV, fig. B.

steam, and at different rates of rotation of the disc, thus producing different notes. It was tried pointed downwards, and sideways from the observer; and the effect of its sound without the 16 feet trumpet was also tested. Subsequently the Engineer to the Trinity House, Mr. James N. Douglass, has adapted the caloric engine for working the siren; and this, besides being less dangerous, and requiring no water, will, by reason of its simplicity, enable the apparatus to be managed by the lightkeepers in the employ of the Trinity House, and thus to be worked as efficiently and more economically than by a steam-engine.

In the Report of the United States Lighthouse Board for 1874, the relative power of these instruments is thus stated:—First class siren as 9; twelve-inch whistle as 7; and the first class Daboll trumpet as 4; while the expenditure is as follows:—

	Siren.	Whistle.	Trumpet.
Coals per hour	180 lbs.	60 lbs.	20 lbs.
Water per hour	126 galls.	40 galls.	None.

Guns.—With reference to guns I shall say very little, seeing that Major Maitland is to bring the subject before the Institution on the evening of Monday the 17th instant; but a brief allusion to the various guns made use of by us in our experiments is necessary. We were kindly supplied with a 13-inch mortar, an old fashioned long 18-pounder gun (similar to the guns now in actual use as fog-signal guns), and a 5½-inch short cast-iron howitzer. These various guns were tried under different circumstances of wind and weather, with small and large charges of powder, and in comparison with the other sound-producers.

Observations and General Results.

Having thus briefly described the instruments used, we will now proceed to the consideration of the observations made, and the general results obtained therefrom. The observations were almost all made at sea, on board one of the yachts belonging to the Trinity House, the scene of operations being shown on the diagram on the wall, and there were always three, four, or more observers from the Trinity House present, and Dr. Tyndall was very rarely absent. These observations were carried on in all sorts of weather, so that the effect of the various meteorological conditions on sound-transmission might be thoroughly tested; and the same experiments were repeated again and again, in order to leave no room for doubt as to the conclusions arrived at. From the middle of May, all through the summer, up to the end of November, the trials were carried on at brief intervals; and in the thick foggy weather of February in last year they were again resumed for a short period.

In stating to you the results obtained from the investigation, in addition to my own experience, I shall avail myself largely of the

exceedingly valuable report made by Dr. Tyndall on the subject, and of a memorandum upon the whole subject made by Sir Frederick Arrow, the Deputy Master of the Trinity House, with the object of making practical use of the knowledge gained.

The objects of the investigation may be classed under two general headings (1), to determine which instruments yield the most effective sounds, and (2), to gain more knowledge as to the manner in which sound is propagated through the atmosphere, particularly during the existence of fog.

With regard to the instruments tried, to which I have already alluded, the results obtained may be thus stated.

Whistles.—I cannot now do better than quote from Sir F. Arrow's memorandum: "Throughout the trials, their marked inferiority to "the other instruments has been recorded. The American whistle "yielding a harsh roar, when close at hand was deafening; but its "sound failed to penetrate to any useful distance. The Canadian "whistle appears to have been better, but it also failed in general "effective power, although occasionally it was heard at great dis- "tances. As a rule, the whistles were behind the siren, trumpet, and "gun, and seem to have been more dependent than the other instru- "ments on exceptional atmospheric conditions for yielding their best "results. The general conclusion seems to be, therefore, that for "practical purposes the steam-whistles, as at present tried, are proved "to be advantageous as fog-signals."

This conclusion, I may say, is fully borne out by the trials. It may be that the all-round diffusiveness of the whistle-sound weakens it so much that there is not force enough to send the sound to any distance; certainly the noise close at hand is extremely distressing. The results claimed for steam-whistles in Canada and America were by no means obtained in our experiments from the Canadian and American representative whistles sent over here, but it is possible that the difference between the atmospheres of the North American coasts and our southern shores in some measure accounts for this. Under certain very favourable circumstances the Canadian whistle has been heard at great distances; but at such times it is probable that any sound of moderate power would have been audible at the same distance. The real test of a fog-signal is in regard to its ability to overcome obstructing influences; and in this respect all the whistles were far inferior to the other sound-producers, for which reason I have refrained from entering into details respecting their construction, &c

American Lighthouse Board Report for 1874, thus reports upon the whistle. "The sound of the whistle is equally distributed hori- "zontally; and when the whistle is upright, in the ordinary position, "its sound is more distinct in a horizontal plane passing through the "whistle than above or below it."

Air-horns.—These instruments, generally speaking, proved themselves fairly efficient. They were certainly superior to the whistles; and, as Sir Frederick Arrow justly remarks, "the satisfactory per- "formance of the trumpets during the late trials fully justifies their "present employment." It seems to me, however, that there are

some objections to the trumpet being made of brass, and also to the necessity which exists for tuning the reed in unison with the trumpet. The use of a trumpet consists chiefly in concentrating the sound into a beam, and thus causing it to be projected through the air with greater force in any required direction. The brass trumpet no doubt does this to certain extent, but as the molecules of the metal are also set in vibration, sound appears to be given off from all parts of the external surface of the trumpet, so that although a very loud sound may be produced in the immediate neighbourhood of the instrument, it is open to doubt whether that sound is transmitted with force to any great distance, its strength being, so to speak, dissipated in the space close to its source. I venture to throw out this idea, and hope it will call forth some authoritative corroboration or contradiction. I would further observe in reference to the tuning of the reed, that there is no doubt it requires a skilled hand and a musical ear to do this properly; and in the event of a reed breaking or cracking (to which reeds are liable when subjected to great pressure) it is not at all likely that a light-keeper would be able to put in another reed and tune it to the proper note, which contingency might cause some inconvenience in the actual working of a fog-signal.

The Siren.—We now come to the instrument of which Dr. Tyndall says, that "it is beyond question the most powerful fog-signal which "has hitherto been tried in England. It is specially powerful when "local noises, such as those of wind, rigging, breaking waves, shore-"surf, and the rattle of pebbles have to be overcome. Its density, "quality, pitch, and penetration render it dominant over such noises "after all other signal sounds have succumbed."

If nothing else had been demonstrated in our lengthened investigation, it would alone have been a most satisfactory achievement to make known the transcendent power of this instrument over all others. Its superiority consists in its general effectiveness up to a certain point under all conditions of wind and weather. Dr. Tyndall says:—"What may with certainty be affirmed is, that in almost all cases the "siren, even on steamers with paddles going, may be relied on at a "distance of two miles; in the great majority of cases it may be relied "upon at a distance of three miles, and in the majority of cases at a "distance greater than three miles." No other instrument, not even the gun, has proved itself able to cope with obstructive influences so well as the siren. With regard to the objections which it seems to me may be preferred against the brass trumpet and its vibrating reed, I would here observe that the trumpet of the siren is of cast iron, and does not take up the vibrations caused by the rapidly succeeding puffs of steam passing through the two discs. The whole of the sound produced is condensed in the siren trumpet, and sent out with great force in a more or less continuous but ever-widening beam. In our trials, the sound was invariably observed to be most effective when we were in the line of the axis of the trumpet. No tuning is required for this instrument; it is simply necessary to make the rotating disc revolve something over 2,000 times a minute by a simple mechanical arrange-

ment. In the experiments, steam alone was used for sounding the siren; but recently it has been successfully tried with compressed air. Mr. Douglass, the Trinity-House Engineer, having arranged for the requisite pressure of air being supplied by a large caloric engine, the results, as compared with those given by an equal pressure of steam, proved that there was little or no difference between them. It will therefore be practicable to establish powerful fog-signals on the siren principle at many places where steam would not have been available.

Guns.—Of the three kinds of gun tried at the South Foreland, the short cast iron 5½-inch howitzer, with a 3 lb. charge of powder, certainly proved itself the best. One of the advantages of a gun report is its distinctive sound; but, under present arrangements, the duration of the sound is so short that it is liable to be obliterated by local noises, and is not easily picked up unless the observer is very close to the gun. The prolonged blast of the siren stands a far better chance of being heard than the short and sudden report of a gun. This consideration has induced the Corporation of the Trinity House to seek the assistance of the War Department in the construction of a special form of gun for fog-signal purposes, which will obviate some of the disadvantages to which the ordinary gun is liable. I need not say that the War Department responded most willingly to the request of the Trinity House; and on the evening of the 17th instant we shall have the great pleasure of hearing Major Maitland state how far they have gone in the matter. Under these circumstances, I need not pursue the question of guns any further.

From the foregoing remarks it will be seen that the siren stands out unmistakeably as the most efficient instrument for coast fog-signals known at the present time. This then concludes the first division of our observations; and I now will proceed to give you the details of the knowledge gained in regard to the propagation of sound through the atmosphere, specially with reference to making sound-signals in fog.

This portion of my subject relates essentially to a matter of scientific demonstration, and I must therefore draw my inspiration almost entirely from the Report of Dr. Tyndall, which gives the results of his persevering and learned researches.

For the sake of convenience I shall endeavour to put before you the results obtained under different headings; and in doing so it will be seen that the various meteorological conditions will be dealt with at the same time.

Fluctuation of Sound.—Almost the first noteworthy circumstance observed during the investigation, was that, independently of wind or weather, the sound range of the different signals varied considerably from day to day. Dr. Tyndall remarks, with reference to the observations made from 19th May to 2nd July:—

"In the foregoing observations we have had very remarkable "fluctuations in the range of the sound, that range varying from "three or four miles on May 19, to 10½ or 12¾ miles on the 1st of "July. The direction and force of the wind, known to exercise a "potent influence upon sound, entirely fail to account for these

"fluctuations, nor could any other observed meteorological element "be held responsible for them."

On two days, apparently alike in respect of wind and weather, the sound-range would vary in an unaccountable manner. These astonishing results could only be referred to invisible differences in the atmosphere, which Dr. Tyndall thus explains:—

"Thus each succeeding day provided us with a virtually new "atmosphere; clearly showing that conclusions founded upon one "day's observations might utterly break down in the presence of the "phenomena of another day. This was most impressively demon-"strated on the day now to be referred to. The acoustic impervious-"ness of the 3rd of July was found to be still greater than that of "the 2nd, while the optical purity of the day was sensibly perfect. "The cliffs of the Foreland could be seen to-day at ten times the dis-"tance at which they ceased to be visible on the 1st, while the sounds "were cut off at one-sixth of the distance. At 2 P.M. neither guns "nor trumpets were able to pierce the transparent air to a depth of "three, hardly to a depth of two miles. This extraordinary opacity "was proved to arise from the irregular admixture with the air, of "the aqueous vapour raised by a powerful sun. This vapour, though "perfectly invisible, produced what I have called an acoustic cloud "impervious to the sound, and from which the sound-waves were "thrown back as the waves of light are from an ordinary cloud."

The importance of the knowledge gained as to the fluctuation of the sound-range on different days will be evident to all present from the following further remarks of Dr. Tyndall:

"In a report written for the Trinity House on the subject of fog-"signals, my excellent predecessor, Professor Faraday, expresses the "opinion that a false promise to the mariner would be worse than no "promise at all. Casting our eyes back upon the observations here "recorded, we find the sound-range on clear, calm days varying from "$2\frac{1}{2}$ miles to $16\frac{1}{2}$ miles. It must be evident that an instruction "founded on the latter observation would be fraught with peril in "weather corresponding to the former. Not the maximum but the "minimum sound-range should be impressed upon the mariner. "Want of attention to this point may be followed by disastrous "consequences."

General Duane, in the Report of the United States Lighthouse Board, 1874, thus reports:—"From an attentive observation during "three years of the fog-signals on this coast, and from reports re-"ceived from captains and pilots, I am convinced that in some con-"ditions of the atmosphere the most powerful signals will be at times "unreliable."

This view entirely coincides with that always followed by the Trinity House in all matters relating to coast marking; they endeavour to give the mariner information upon which he can depend, and refrain altogether from publishing statements which are merely "probable." The siren, however, of all the instruments, proved itself to be the best able to cope with this obstructive influence, and as, I have before observed, may be relied on under any circumstances

at a distance of two miles, and in the majority of cases at a distance of three miles, therefore to that extent the fluctuation of the sound may be obviated by the use of the siren.

Aërial Echoes.—The obstruction of sound by the irregular distribution of invisible aqueous vapour in the atmosphere has, as Dr. Tyndall observes, its complementary side. The question is, what becomes of the mass of sound so impeded? It seemed incredible that a great body of sound should be utterly annihilated in the short space of three miles, when on other occasions the same force of sound had travelled 16¾ miles. Was it wasted entirely, or could it have been reflected back? The proof was at hand, and here is Dr. Tyndall's description of it, he having gone ashore at the Foreland and landed at the base of the cliff:

"The body of air which had already shown such extraordinary "power to intercept the sound, and which manifested this power still "more impressively later in the day, was now in front of us. On "it the sonorous waves impinged, and from it they were sent back to "us with astonishing intensity. The instruments, hidden from view, "were on the summit of a cliff 235 feet above us, the sea was smooth "and clear of ships, the atmosphere was without a cloud, and there "was no object in sight which could possibly produce the observed "effect. From the perfectly transparent air the echoes came, at first "with a strength apparently but little less than that of the direct "sound, and then dying gradually and continuously away: the echoes "reached us, as if by magic, from absolutely invisible walls."

This, therefore, was a striking and most satisfactory corroboration of the theory formed by Dr. Tyndall as to the aërial obstruction of sound. Further, in reference to the subject, the Professor remarks, "Whatever might be the state of the weather—cloudy, serene, stormy, "or calm, the aërial echoes, though varying in strength and duration "from day to day, were never absent, and on many days under a per- "fectly clear sky they reached (in the case of the siren) an astonish- "ing intensity."

Effect of Wind upon Sound Transmission.—Throughout the trials, adverse winds proved to be very potent in obstructing the passsage of sound; this result is in accordance with general experience. But I may state that even against a wind of force 4 or 5, the sound of the siren is able to penetrate to a distance of about three miles, and would be of service to a mariner within that distance. No other instrument was able to cope so successfully with the opposing force of the wind. Happily thick fog is rarely accompanied by strong wind, and, therefore, the obstructive power of the latter element is not likely to be brought into play at times when a fog-signal would be generally serviceable. But it is a satisfactory result of the trials, to be assured that in thick, rainy, windy weather, when a sound-signal would be of great value, the siren will convey a warning to the sailor at more than two miles distance from the danger the signal is intended to mark. It was found that when the siren was pointed to windward and the whole strength of the sound projected right against the opposing force of the wind, it gave the most satisfactory results,

the wind carrying the sound effectually to the leeward part of the arc required to be guarded: this pointing to windward will therefore be always adopted in future. Whilst upon this subject, I may add that the passage of sound across the wind was not found to be impeded to any great extent by the action of the wind.

In the Report of the United States Lighthouse Board, page 114, an instance is recorded in which the sound was lost in the eye of the wind at 5 miles, whereas with the wind it only reached $4\frac{1}{2}$ miles; velocity of wind by anemometer $10\frac{1}{2}$ miles per hour; and it is further stated that this is the only instance on record in which the sound has been heard further against than with the wind.

Effect of Rain, Hail, and Snow.—With regard to falling rain and hail, it was most clearly demonstrated that no obstruction is thereby offered to the passage of sound, but on the contrary, it was proved that the effect is rather to remove obstructions, as may be seen from the following quotations from Dr. Tyndall's report:—

" The heavy rain at length reached us, but although it was falling " all the way between us and the Foreland, the sound, instead of being " deadened, rose perceptibly in power. Hail was now added to the " rain, and the shower reached a tropical violence. The deck was " thickly covered with hailstones, which here and there floated upon " the rain water, the latter not having time to escape. In the midst " of this furious squall both the horn and the syren were distinctly " heard; and as the shower lightened, thus lessening the local noises, " the sounds so rose in power, that we heard them at a distance of $7\frac{1}{2}$ " miles, distinctly louder than they had been heard through the " rainless atmosphere at 5 miles."

I would remark that in every instance of falling rain during the experiments, the sounds were heard more plainly than on many fine clear days. This is an important addition to our knowledge in regard to the propagation of sound, for it had hitherto been the general opinion that falling rain had a stifling effect upon sound. As respects snow, Dr. Tyndall quotes his own experience in the Alps, to show that no interruption of the sound-wave is caused by snow showers.

Effect of Fog.—Previously to our experiments, it had been generally supposed that the effect of fog upon sound was to deaden it; certainly there existed but little real knowledge on the subject. The result of the experiments, however, made in the dense fogs of February, 1874, proved conclusively that fog does not impede the transmission of sound, but on the contrary, that a foggy atmosphere appears to be a highly favourable condition for the travelling of the sound-wave. In reference to this matter, Dr. Tyndall says:—

" The experiments thus far made are perfectly concurrent in in- " dicating that at the particular time when fog-signals are needed, " that is, during foggy weather, the air in which the fog is suspended " is in a highly homogeneous condition; hence it is in the highest " degree probable that in the case of fog we may rely upon these " signals being effective at much greater distances than those just " mentioned."

He adds a few words of scientific explanation as follows:—

"It is hardly necessary for me to say a word to guard myself "against the misconception that I consider sound to be assisted by "the fog itself. Fog I regard as the visible result of an act of con-"densation which removes the real barrier to transmission, that "barrier being aqueous vapour, so mixed with air as to render it "acoustically flocculent or turbid. The fog particles appear to have "no more influence upon the waves of sound than the suspended "matter stirred up over the banks of Newfoundland has upon the "waves of the Atlantic."

It is in the highest degree satisfactory to have this point solved so conclusively, for in regard to the whole question of signalling by means of sound in foggy weather, it shows us where we stand, and we know now that when light is rendered ineffectual by fog, we may trust to sound to carry on the important duty of signalling to the mariner.

In reference to the knowledge gained as to the effect of different meteorological conditions upon the transmission of sound through the atmosphere, I may remark that in many respects nautical men will find it of great value, independently of its connection with fog-signals. It is well known that in the practice of navigation not a little is done by means of sound—the use of speaking-trumpets for hailing; of gun-signals to indicate distress, &c.; of steam-whistles for signalling, is more or less common among merchant ships, and in the Royal Navy also a great deal is done by means of sound-signals. By the results now obtained, mariners will undoubtedly understand better how to make such signals effective, if they will give consideration to the influence exercised upon sound by the various atmospheric conditions. Here is a small and very effective horn which is used when fog comes on suddenly until the fog-signal is in proper working order. This instrument is really a good one, and should be used on board ship instead of the poor, weak instruments so often seen on board. Formerly this old bellows-horn was used, but the new instrument is a vast improvement, and therefore I think worthy of being brought to your notice. It is patented in America, and I think here also, by Mr. Anderson, the inventor.

Professor Henry, Chairman of the United States Lighthouse Board, thus reports on the fluctuation of sound at page 107 in the report for 1874:—

"The phenomena which had been observed at this and other stations "along the coast, consisted of great variation of intensity of sound "while approaching and receding from the station. The vessel was "approaching Whitehead from the south-westward, when at a distance "of about six miles from the station the fog-signal, which is a 10-inch "steam-whistle, was distinctly perceived, and continued to be heard "with increasing intensity of sound until within about three miles, "when the sound suddenly ceased to be heard, and was not perceived "again until the vessel approached within a quarter of a mile of the "station, although from conclusive evidence furnished by the keeper "it was shown that the signal had been sounding the whole time."

Positions for Coast Fog-Signals.—Sir Frederick Arrow in his

memorandum, says, with reference to the question as to the height above the sea at which a signal should be placed, that the results of the trials "show that it is advantageous that such signals should be "placed at a considerable height above the sea level, in order to avoid "the interference caused by the noise of waves breaking on the shore, "the rattle of pebbles, &c." This is an important consideration. But in connection with the selection of sites for fog-signals, it has also been shown to be necessary to take into account the possible effect of a sound-shadow, caused by the interference of a projecting point or cliff in the vicinity, on the passage of the sound over the entire area intended to be guarded. The effect of such a sound-shadow was experienced again and again in an experiment at the South Foreland. The Committee to America also made a recommendation to the same effect, and the recent investigations entirely bear out the opinion expressed by that Committee.

Whilst touching upon this subject of positions for fog-signals, I think it well again to quote from the valuable memorandum of Sir Frederick Arrow, in reference to another important point. His opinion is, "That no signal should be required to mark dangers ex-"tending seaward, more than a mile or a mile and a quarter. The "minimum effective range of a signal being 2½ miles; vessels "approaching such dangers and coming into the sound-range, would "have room to manœuvre, and be able to keep at a safe distance." These various questions, in relation to choosing the positions for fog-signals, have a very important bearing on the practical work of establishing such signals, and the views expressed will be of great service in assisting the Trinity House in their selection of new sites.

Distinctive Sounds.—The next point with which I have to deal, is also one of the greatest importance, viz., the question of distinctions between adjacent signals. It would not do for all signals to be sounding alike, at least, not if the sound-signal is intended to perform the duty of a light which is obscured, the character of which may be fixed, revolving, or what not, and which should indicate to the mariner where he is. It is necessary, therefore, to diversify the signals, but at the same time it is imperative that the utmost simplicity be followed in any distinctions which may be adopted. In the experiments, it was found that the sounds of the whistle, horn, and siren, though differing slightly, resembled each other so much that it was only by the nicest discrimination that any difference was appreciated; indeed, Sir Frederick Arrow very justly remarks that "the siren, horns, and whistles, have "invariably been spoken of by sailors in the vicinity as the fog-"horns," and they failed altogether to appreciate any difference between the sounds. For purposes of distinction, therefore, the variation of the length of the silent interval between the blasts of a siren will, it is hoped, prove efficacious, provided the distinctions are of the most simple and intelligible description. Anything complicated, requiring careful and trained observation, will be out of the question. It is in this respect that hopes are entertained of the gun being made valuable. Between the sound of a gun-report, and that of a siren-

blast there is a perfectly intelligible difference, which the most ordinary intelligence would understand. I am, however, of opinion that something satisfactory may be achieved by combinations of sounds differing greatly from each other. In the case of the siren, for instance, which could be adapted for such an arrangement, it would be quite possible to sound two distinct notes in tolerably quick succession, say a high note followed by a bass one. The contrast would sufficiently indicate itself, and be a perfectly intelligible distinction. I do not believe it would be of any use for distinctive purposes to have a signal of one note at one station, and one with a different note at another, in the expectation that sailors would understand and guide themselves by the distinctiveness of each sound; but I do think that the direct contrast of two notes could not fail to be understood, and thus be made to convey to the mariner the information as to what signal it was he heard. I guard myself against recommending any elaborate system of distinctions for sound-signals, but I am of opinion that this notion of contrasts may be further developed without introducing complications. It might be possible also to have a gun-report and a siren-blast placed in direct contrast; this again, I believe, would provide an adequate distinctiveness. The subject is one which experience will develope; and in pointing out the present condition of this branch of my subject, I have also stated my own views as to what may be achieved in this respect.

Conclusion.—I now come to the end of my subject, having put before you what I consider the various points of interest and importance connected with the protracted investigation in which I had the honour to be engaged; and in concluding my paper, I feel that I cannot do better than quote the admirable remarks of Sir Frederick Arrow on this great question. He says, "The subject of fog-signals "has by means of this investigation received a great impetus; it may "fairly be said that we have taken a considerable step in advance, "and it only remains to follow it up. As we go forward, our ex"perience will widen, and although it is more than probable that "a few years of practical experience and testing of fog-signals "will materially modify our present views, and improve considerably "the instruments we have, yet we know now how to go forward, and "in what direction to bend our efforts. It is to be hoped that before "very long our coasts will be guarded by a complete chain of sound"signals, all effective and useful to the mariner. * * It is almost "unnecessary to add that in thus giving practical effect to the spirit "of the recommendations of this valuable report, the Elder Brethren "will have the satisfaction of knowing they are acting in the highest "interests of humanity, and conferring an inestimable boon on the "nautical community at large."

To this I would add that, in accordance with the recommendations, the Trinity House have already arranged for the placing of no less than twenty new fog-signals on our coasts, the works for which are now in hand; and these when completed will be succeeded by others, so that in a very short time our coasts will be surrounded by a complete chain of fog-signals. Thus are the Trinity House making

practical use of the results obtained from their recent experiments in relation to fog-signals.

Finally, I have to express my very great obligations to Sir Frederick Arrow, and to Dr. Tyndall, for a considerable part of the material of my lecture. Both gentlemen have most cheerfully given me free permission to make use of their reports, and I need hardly say that the assistance thus derived has been of the greatest service to me, and I trust of interest to you. I am also much indebted to Mr. E. P. Edwards, of the Trinity House, for the assistance he has given me in preparing this report. The whole subject has been dealt with in a most persevering and masterly manner by Dr. Tyndall; and for his self-sacrificing labours not only the Trinity House, but the world at large, owes him a debt of gratitude. I would he had been here in my place to describe to you in his own brilliant and lucid style what I have attempted to put before you in so imperfect a manner.

Evening Meeting.

Monday, May 17th, 1875.

MAJOR-GENERAL F. M. EARDLEY-WILMOT, R.A., F.R.S., in the Chair.

NAMES of MEMBERS who joined the Institution between the 4th and 17th May, 1875.

LIFE.

Taylor, A. H., Captain 21st Hussars.
Wingfield, C. G. L., Lieut. 54th Regiment.
Troyte, John Edwd., Lieut. 4th King's Own Regt.
Harmar, C. D. O., Lieut. 39th Regt.
Perrott, Herbert C., Lieut. East Kent Militia.

ANNUAL.

Meurant, Edwd., Major 83rd Regt.
Macpherson, Jas. F., Captain and Adjutant Border Rifles.
Scriven, A. G., Lieut. 52nd Regt.
Parkinson, C. F., Major 95th Regt.
Robinson, H. A., Captain 16th Lancers.
Wilkinson, G. A., Lieut.-Col. R.H.A.

FOG-SIGNALLING BY EXPLOSIVES.

By Major MAITLAND, R.A., Assistant-Superintendent, Royal Gun-Factory, Woolwich.

ON Friday week Admiral Collinson read a paper in this theatre which was listenedto with great interest, on the general subject of "Fog-Signals." He described fully certain experiments which were carried on in 1873 at the South Foreland by the Trinity Board, under the watchful care of Professor Tyndall. He explained that under some conditions of the atmosphere the sounds produced by horns, whistles, and notably by the siren, penetrated the distance more successfully than those of guns; while, under other conditions, the dull thud of an explosion made itself heard when all other sounds were stilled. The note of the most powerful instrument yet tried—the siren—resembles a harsh, prolonged scream, and thus is less likely to be annulled by a puff of wind or a local disturbance than the very brief sound of a gun; on the other hand, the latter sound, when heard, is less likely to be mistaken or overlooked, for, as most of those present have probably experienced, the report of a piece provokes instant attention.

The Elder Brethren of the Trinity Board therefore conceived the idea of differentiating the signals, by placing sirens on board light-ships and guns on shore stations, so that the befogged mariner might be able to tell approximately what part of the coast was near him.

Admiral Collinson explained also that on different days the atmosphere varied greatly, so much so that sounds audible up to 15 miles one day were lost at 3 miles on another. This irregularity affected all sounds in about equal degrees.

Three kinds of guns were tried during the experiments, all were of cast-iron, one being an 18-pr. gun, one a 24-pr. howitzer, and one a

13-inch mortar. Each was fired with a charge of 3 lbs. of powder and a junk wad, and the 24-pr. howitzer proved clearly the most efficient. During a long-continued fog it was found that two men serving the gun could not keep up the firing more rapidly than at the rate of one discharge in a quarter of an hour; this interval was too long. A ship might readily run into great peril in the time, especially if she chanced to miss hearing but one signal. It was therefore thought desirable to curtail this period to five minutes at the most. Affairs stood thus when the Trinity Board decided to apply to the War Office for a solution of the following problem:—

To produce the most far-reaching sound possible with a charge of 3 lbs. of powder, and to enable two men to keep up the firing at intervals of not more than five minutes during a long-continued fog.

The matter was referred to Colonel Campbell, R.A., Superintendent of the Royal Gun Factory, whose assistant I have the honour to be; hence I have been asked to give you a brief account of the experiments which have been carried on at the Royal Arsenal to determine the solution of the above question.

The problem divides itself into two parts,—ease of working and propulsion of sound. We will take ease of working first. The principal part of the labour consists in sponging out and ramming home. When blank cartridge is fired it sometimes happens that a piece of the serge is left behind, smouldering in the bore, and this may ignite the fresh cartridge prematurely; therefore, sponging out has to be carefully performed. To avoid the labour consequent on these two operations, a machine—it can scarcely be called a gun—was devised in the Royal Gun Factory. (See Pl. xv.) The fore part consists of a barrel open at both ends, the interior diameter being 5 inches and the length 21 inches. The breech end of the barrel abuts in a close-fitting joint against the mouth of a chamber, formed in a horizontal wheel containing five chambers. This wheel revolves on two vertical trunnions. The chambers are 7 inches in depth, and, like the barrel, 5 inches in diameter. The trunnions fit into bars, which are a continuation of the barrel, and by means of powerful screws in rear, the wheel can be pressed as close against the barrel as necessary. The joint is closed with a ring of steel, somewhat on the principle of the throat-valve of a hydraulic press.

A passage communicates through the top of the breech-carrier with the rear of the chamber next the barrel. This passage is so arranged, by means of a catch-spring, that the communication is interrupted except when a chamber is exactly fitted to the barrel, and then only can the gun be fired. This is accomplished by means of an ordinary tube dropped into the passage.

Since there are five chambers round the wheel, each is used only once in five reports; and supposing five minutes to elapse between the reports, each chamber will be used but once in 25 minutes, and thus no smouldering fragment can ignite the succeeding cartridge.

The gunner wheels up a covered barrow, containing a supply of cartridges, to the left side of the gun, with the left hand places one in the chamber next to be fired, and with the right hand turns the wheel,

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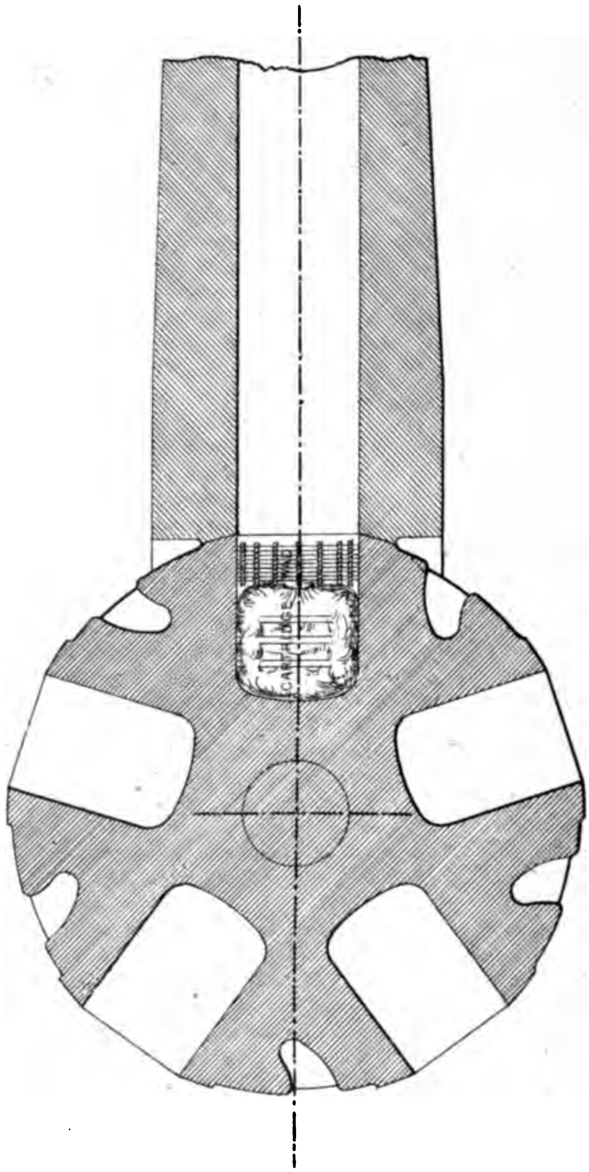


SKETCH OF GENERAL IDEA OF PROPOSED BREECH LOADING SIGNAL GUN.

J. Jobbins

which locks itself in the required position. He then drops a tube into the vent passage, and fires. No ramming home or sponging out are required.

The design has met with the approval of the Elder Brethren and their scientific advisers, and probably will ere long be put to the test of actual trial. Of course a method of this sort would be quite unadapted for warfare, being constructed merely to fire blank cartridge, which causes comparatively low pressure on the metal.

We now come to a much more difficult question, that of the propulsion of sound. The designing of a gun is a simple problem, and one which falls into the routine of every-day work; but the production of sound is quite another matter. We have hitherto looked upon the noise of a discharge as a necessary evil, and have altogether neglected it. What, then, have we to go upon? What is the cause of the report of a gun? Clearly the sound is made up of two factors, as was indeed pointed out by Professor Tyndall in his comments on the design I have just shown you. One factor is the blow struck by the expanding gas on the still air, the other is the vibration of the metal of the gun. Bronze guns have always been considered more trying to the ears of artillerymen than iron ones, and it was thought that the sonorous qualities of the metal would be of value in sound-propelling; hence the gun, whose design I have explained, was intended to be made of bronze. Professor Tyndall, however, at once surmised that the advantage thus gained would disappear as the distance of the listener increased, and he proposed to cheapen the apparatus by employing cast-iron.

It is found that when a gun is fired, if a line be drawn across the muzzle at right angles, a great difference in the intensity of the sound is experienced by the observer, according to whether he places himself a little before or behind this line. Any one can readily convince himself of this fact by going to Shoeburyness when 38-ton guns are being fired. I think it probable that the first trial in front will amply satisfy him. It would appear, then, that the rapidly expanding gas strikes a violent blow on the air in front of the muzzle, and, failing to drive the mass away at once, sends its vibrations forcibly out on all sides. The state of the ground under the muzzle when heavy guns are fired confirms this view.

Now, sound, as you are aware, is propagated by alternate compression and expansion in the direction in which it is travelling; light, on the other hand, vibrates at right angles to the ray: nevertheless, it is found that sound behaves like light in many ways. Thus, if a wave of sound impinge on a flat surface at any angle it will be reflected at the same angle. This property is of great value to the fog-signaller; a simple experiment will suffice to illustrate it. Place two tubes to form an angle like the letter V, and fix a flat surface at the point; a sound travelling through one tube will be reflected through the other if the flat surface be placed at the proper angle.

In order to catch the vibrations passing to the sides of the muzzle, it was proposed to enlarge the mouth of the gun into the form of a wide-spreading cup. It is not easy to ascertain precisely the distance

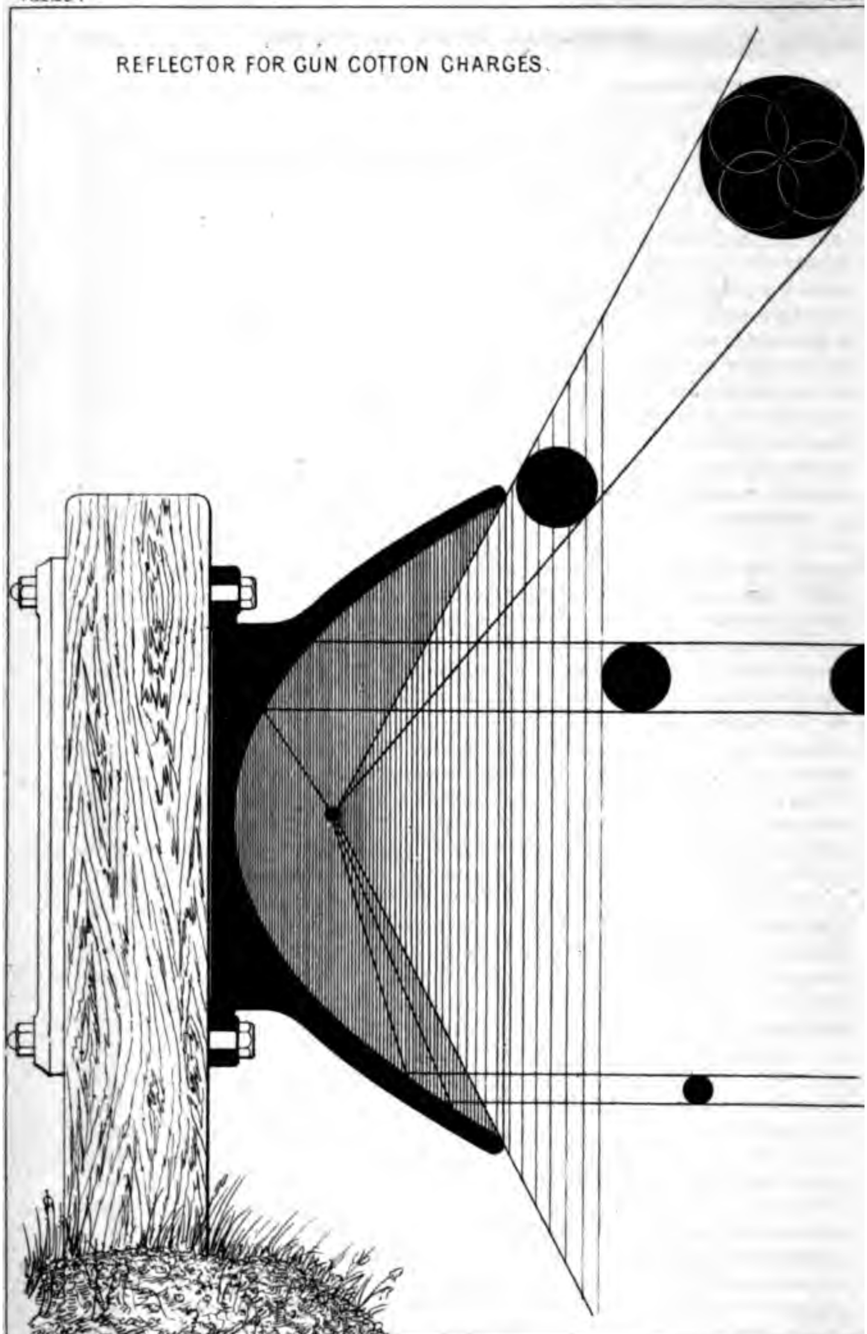
in front of the muzzle at which the expanding gas strikes with the greatest force, but it is tolerably clear that when once this point is ascertained it may be made the focus of a parabola. This curve possesses the property of propelling reflections in parallel lines straight forward when any part of it is struck from the focus. (Pl. xvi.)

Now, as is well known, most forces, such as attraction, heat, sound, act in proportion to the inverse squares of their distances. If the sun were at half its present distance from us it would give us four times as much heat; if at one-third of its distance, it would give us nine times as much heat. Thus, when a sound is originated, it propagates its vibrations in all directions equally. If it starts in the centre of a hollow sphere it will strike all parts of the interior surface with equal force. Substitute a hollow sphere whose diameter is twice that of the first and the sound will still strike all parts equally, but will be diffused over a surface four times as large, and therefore each square inch of the interior surface of the large sphere will receive only one-fourth of the sound impinging on each square inch of the small sphere. I trust I may be pardoned for introducing such elementary considerations, as it is safest to be quite clear on so important a point.

Now, observe what takes place when sound is generated in the focus of a parabola. (Pl. xvi.) It radiates at first in all directions. You see two diverging rays passing out of the front of the reflector; the effect of these follows the law of inverse squares just alluded to, but the other rays which strike the curve are reflected in parallel lines, and the space they cover remains constant whatever the distance may be. From this it appears that if a sound be generated accurately in the focus of a parabola the reflected portion will travel to any distance unimpaired, if no disturbing cause exist. As a matter of fact, since the focus is a mere point no sound-producer can accurately occupy it, and a certain amount of dispersion will always take place; also the atmosphere absorbs and reflects a portion of the vibrations. The result of these actions is that the loss of power, instead of varying with the square of the distance, varies approximately with the first power of the distance. That is, while a sound produced in the open has but one-fourth of the power at two miles that it has at one mile, a sound produced in the focus of a parabola has about one-half, and thus the force is taken from behind, from the sides, from above, from below, where it is not wanted, and is propelled in the most desirable direction.

I have here two parabolas, exactly of the same size and form. In the focus of one is placed the root of the sensitive flame. You see that the crumpling of a piece of paper is sufficient to excite the flame. I increase the distance, the agitation lessens till, at about 10 feet, the flame becomes quiet. The other parabola is then brought up facing the flame, and as soon as the focus coincides with the sound-producing paper the flame dances once more.

Mr. Douglas, Engineer to the Trinity Board, made some trials at the South Foreland, with a fowling-piece placed in the mouth of the siren, which somewhat resembled a cone, and finding that a considerable improvement resulted, he expressed a wish that this kind of mouth should be tried. Accordingly some preliminary experiments were



J Jobbins

carried out at the proof butt at Woolwich Arsenal, and I have laid on the table the instruments which were actually tested.

There are two other points in designing a gun to produce the greatest possible noise with a given charge to which I must now allude. These are the diameter and the length of the bore. As the sound is occasioned by the blow of the expanded gas on the air, the more sudden we can make this blow the louder will be the sound. It becomes an object, then, to cause the powder to burn up as rapidly as possible; for this purpose the grain must be small, so as to consume quickly, and the shape of the charge should approach that of a sphere. The former condition is fairly satisfied by the "large grain" (L.G.) powder of the service, the much abused *poudre brutale*, which is the smallest used for guns, having been termed "large grain" in comparison with the "fine grain" used for small arms before the enlarged modern powders were introduced. The latter condition is arrived at for 3 lb. of powder by making the bore of the gun 5 inches in diameter, the cartridge will then be 5 inches long as well as 5 inches thick.

So much for the calibre of the gun—next for the length. It is desirable that the powder should be all burnt up before leaving the bore. A wad is, therefore, added of sufficient mass to prevent the foremost grains of the quick-burning powder from being driven out unburnt. It will be in the recollection of many, how blank charges of the slow-burning pebble powder peppered a yacht when the Shah was present at a naval review at Portsmouth. The bore of the gun should be of sufficient length to allow of the thorough consumption of the powder; but on the other hand, if too long, the elasticity of the column of air in the gun will deaden the blow—the metal will absorb the vibrations—and the whole beneficial effect will be lessened. The happy mean appears to be between 5 and 6 calibres, that is, the bore should be 5 or 6 times as long as it is broad. A slow burning powder, exploded in a bore of too great length, gives a certain *woolliness* to the sound, which is less effective than a sharp clear report.

I took an opportunity, a few days ago, of firing 60 lbs. of powder (R.L.G.) in a 38-ton gun, fitted with crusher gauges for taking the pressures in the bore.[1] A wad, which was not as stiff as it should have been, was placed in front of the cartridge, whose breadth and length were nearly equal. The curve indicating the pressure may be traced from these data:—

At the end of the bore, pressure . .	·76 tons
At 1 ft. from end	4·63 ,,
At 2 ft. ,, ...	2·36 ,,
At 3 ft. ,, ...	1·84 ,,
At 4 ft. ,, ...	·40 ,,
At 5 ft. ,, ... about	·20 ,,

showing that all the work of the powder is practically accomplished at this distance, and confirming the advantage obtained by a length of between 5 and 6 diameters.

I will now describe the experiments which have been carried on at the proof butt, in the Arsenal.

[1] The calibre of the 38-ton gun is 12·5 inches.

Four guns were first tested, viz.:—

No. 1. Cast iron, with plain muzzle.
No. 2. „ with small cone mouth.
No. 3. Bronze, shallow parabolic mouth.
No. 4. Cast iron „ „

They were all precisely similar with respect to charge, length of bore, and calibre; these elements being in accordance with the principles on which I have already dilated. They were fired in a succession of series, and the loudness of their reports was numerically estimated by a party of observers, who increased their distance from the guns at each series, starting from 100 yards and ending at 3,000 yards. A second experiment was then carried out in the same way, except that the observers remained at the longest distance (3,000 yards) all the while. The order of firing was varied, so that no one knew at the time which report he was estimating, and thus poor fallible human nature had no chance of fudging.

The observations, of course, were somewhat obscured by the occurrence of puffs of wind, by the difficulty of estimating minute differences, and by the effect of local noises, but the grand principle of averages came to our aid, and helped us to some valuable results. The method adopted was a simple one: on reducing every man's observations it was found that there was pretty general agreement though not a perfect one. Thus in the first experiment seven out of eight observers placed the small cone first; the eighth placed it third. Adding together these numbers, the total is ten, which gives a mean of 1·25, and this may be called the figure of merit. The lower the figure the better the gun. The cast-iron plain muzzle came out thus:—

4th.	3rd.	2nd.	4th.	4th.	3rd or 4th.	2nd.	4th.

giving a total of 26·5—mean 3·31.

The cast parabola and the bronze parabola were represented respectively by 2·62 and 2·81.

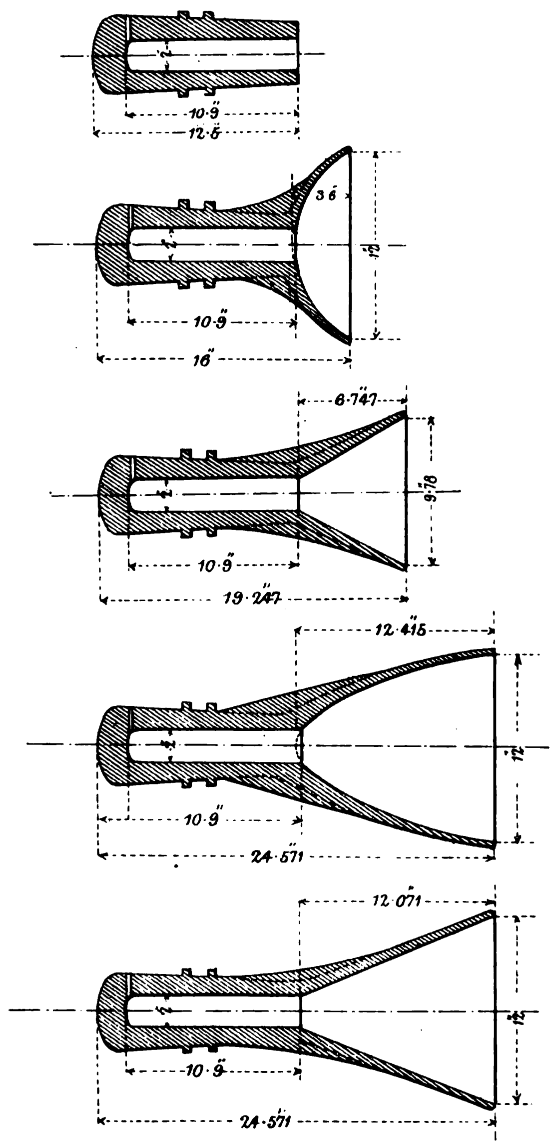
Thus, at the variable distances, the cone was unmistakeably best, and the plain gun worst, while the cast iron parabola slightly beat the bronze one. Turning to the second experiment, where the observers were stationed entirely at the long range, the figures came out thus:—

Cast iron cone	1·00
„ parabola	2·08
Bronze „	3·16
Cast iron plain gun	3·71

The cone was first in every ones estimation, and thus maintained a clear superiority. The general order was preserved, confirming the result of the first experiment. It was evident, however, that the cast-iron parabola had gained, while the bronze parabola had lost. This led at once to the idea that distance was unfavourable to bronze, and the observations of the first experiment were accordingly summed up to 1,000 yards only. The result was that the cone was still first, the

SMALL GUNS USED IN THE EXPERIMENTS AT WOOLWICH.

Scale 1 Inch = 1 Foot.



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bronze parabola was second, the plain gun third, and the cast iron parabola last. This confirmed our suspicions, and showed that Professor Tyndall was quite right in his opinion that any advantage gained by the sonorous qualities of bronze would disappear with increase of distance. It also tended to show that bronze was at a positive disadvantage in this respect when compared with cast iron. It must be remembered that the guns were fired horizontally from the top of the butt in the Arsenal, and for the short ranges up to 1,000 yards, the observers were rather below their level. The parabolas then sent their maximum sound over the listeners' heads, but the resonance of the bronze told at short ranges, and enabled it to beat its fellow parabola and the plain gun. The cone did not collect the sound sufficiently to miss the observers, and therefore beat all the other guns. It has a great advantage over the shallow parabolas in depth.

Professor Abel, Chemist to the War Department, who, though not the inventor of guncotton, may yet be called its stepfather, had conceived the idea that this material would prove more effective as a sound-producer than gunpowder. If it is correct to assume that rapidity of ignition and violence of shock are really the sound-producing qualities, it might certainly be expected that this explosive would be highly successful. Its rapidity of detonation in the open air and in a wet condition reaches 20,000 feet per second. The explosion of powder cannot be compared to it. Guncotton requires no gun to fire it from; can be kept saturated with moisture, so that a red-hot poker will not burn it, and yet in this safe state can be detonated by the addition of a small primer of dry guncotton. Practice would soon accustom the operator to explode charges with certainty, and with little labour; and there is no doubt that its use offers many advantages. The drawback is the price.

In the first trials of sound-producers, 8 ounces of wet guncotton were detonated by 2 ounces of dry material. Thus, a charge of 10 ounces of guncotton was pitted against one of 4 ounces of powder, and as guncotton is at present just three times as expensive as powder no comparison of value could be made. As a matter of fact, the guncotton gave very superior results, as was to be expected, but it was impossible to estimate how far superior. It was therefore determined to include guncotton in the next series of experiments on more definite terms, and in February last the following trials were carried out, Mr. Abel superintending the arrangements for firing the guncotton.

The general arrangements were the same as previously described. Six sound-producers were compared at varying ranges, and also at a constant long range.

No. 1. Cast iron plain gun as before (this gun forms a starting point, representing the ordinary type of howitzer used in the service).

No. 2. Cast iron large cone, new.

No. 3. Cast iron small cone, old.

No. 4. Cast iron parabola, new, having axis and width of mouth equal to those of the large cone No. 2.

No. 5. Guncotton detonated in the focus of a parabolic reflector.

No. 6. Guncotton detonated in the open air.

All the charges, whether of powder or gun cotton, weighed four ounces.

A party of observers estimated the intensity of the reports at ranges varying from 100 to 4,400 yards, and on reducing their records the figures of merit came out as shown in the table:—

No. 1. Plain gun	5·82
No. 2. Large cone	3·71
No. 3. Small cone	4·00
No. 4. Parabola	4·41
No. 5. Guncotton in reflector	1·00
No. 6. Guncotton in open	2·00

The guncotton in a parabolic reflector exhibits an unmistakeable superiority, while the guncotton unconfined is clearly the next best. Of the guns all the specially constructed mouths beat the plain muzzle; the large cone is slightly superior to the small one, which is a little better than the parabola.

Twelve observers next stationed themselves at about 5,000 yards distance. The reduced results were as follows:—

No. 1. Plain gun	5·00
No. 2. Large cone	5·50
No. 3. Small cone	4·33
No. 4. Parabola	3·17
No. 5. Guncotton in reflector	1·00
No. 6. Guncotton in open	2·00

The guncotton charges confirm the previous result, but the order of the guns has now changed. The parabola has risen to the first place, the small cone comes second, while the plain gun and the large cone bring up the rear, the latter being slightly the worst.

Returning to the first experiment and dividing it into two parts, viz., from 100 to 1,600 yards, and from 1,900 to 4,400 yards, we obtain the following results:—

	100 to 1,600 yards.	1,900 to 4,400 yards.
No. 1. Plain gun	4·82	5.55
No. 2. Large cone	4·27	4·00
No. 3. Small cone	3·64	4·86
No. 4. Parabola	5·27	3·59
No. 5. Guncotton in reflector	1·00	1·00
No. 6. Guncotton in open	2·00	2·00

Thus it appears that at all ranges and in every observer's judgment, the guncotton in a reflector is the best, and the guncotton in the open next best; and it may now, I think, be assumed as a fact that when equal weights are employed, guncotton yields a decidedly louder report than powder, while the addition of a parabolic reflector confers a clear seupriority.

The tale told by the guns has more variety of incident. At the shorter ranges near the butt, where the axes of the guns point over the heads of the observers, the parabola is beaten by all, even the plain gun, confirming the result arrived at in the first experiments of

November with the shallow cast iron parabola. As the distance increases, the sound, not having proceeded accurately from the focus, and being moreover somewhat dispersed by the air, spreads out, but much less widely than in the case of the cones, or still more of the plain gun, till the power thus husbanded begins to tell at the long ranges, and gives the parabola an easy victory. The two cones are on the whole nearly equal, and their variations are probably due to the natural errors of the experiment.

In these two trials, equal weights of guncotton and powder were compared on a small scale. In the third experiment, now to be described, equal prices were compared on a large scale. One pound of guncotton was detonated in the open, and charges of three pounds of powder were fired from a 24-pounder howitzer of iron, a 12-pounder howitzer of bronze, and an 18-pounder gun of iron. A charge of 1½ lb. of guncotton was also detonated for comparison, in case this material should offer any important advantages in use, or should become cheaper.

The 24-pounder howitzer gave the best results; next came the 1½ lb. of guncotton, followed very closely by the 1 lb. of guncotton; while the bronze howitzer beat the 18-pounder gun. This experiment was of great importance, the series fired were but few, the results were rendered somewhat doubtful by local noises and gusts of wind, and it was therefore thought desirable to repeat it on a more extended scale.

This was done on the 2nd of May. The day was warm and bright, rain had fallen previously, and the air was moist. The wind was due south, a gentle breeze of fair steadiness nearly dead against the sound. The guns were N.N.E. of the observers, who, eight in number, stationed themselves at a distance of 2¼ miles, in a position free from local noises. Owing to this cause, and to the favourable nature of the day, the concord between the observations was greater than on previous occasions. Seventeen series were fired, and the results of this experiment are entitled to much weight.

The figures of merit come out thus:—

No. 1.	Bronze 12-pounder howr.	3 lbs. L. G. Powder	1·25
No. 2.	Cast iron 24-pounder ,,	,,	2·31
No. 3.	,, 18-pounder gun.	,,	2·69
No. 4.	Guncotton in open.	1 lb.	4·25
No. 5.	,,	1½ lb.	4·50

Thus it appears that all three guns beat the guncotton charges easily, that both the howitzers beat the 18-pounder gun, that the bronze howitzer beat the cast iron one, and that the guncotton charges were practically equal, whether of one, or of one and a half pound weight.

The superiority evinced by the guns firing powder charges equal in price to the guncotton was marked, and it was noticed during the experiment that more difference existed between the reports than had been observed in former trials. This may perhaps be partly due to the circumstance of the wind being against, instead of with the sound. The action of the gun is to drive a mass of vibrating air forward in a

definite direction, while the shock of the guncotton is exceedingly local, as has been shown by Professor Abel in many experiments. The gun may therefore be better able than guncotton to make itself heard against the wind. The advantage gained by the bronze howitzer over the cast iron one is probably due to the diameters of the bores; the cast iron 24-pounder is rather too large for 3 lbs., the bronze 12-pounder is rather too small, and excess in size may be more injurious than defect.[1] Both howitzers again beat the long gun, and confirmation is obtained of the previously formed deduction that shape is of more importance than material.

The equality of the effect of the two charges of guncotton is remarkable, and will require clearing up.

It has been proposed to use as sound-producers for the Arctic Expedition small bronze mortars fired with a tightly fitting wooden plug jammed into the muzzle in order to increase the sound, and a certain number of plugs have been sent to the vessels for the purpose. We have hitherto proceeded on the principle that suddenness of shock was a great element of success in sound-producing by explosives, and since the interposition of an elastic column of air in the mortar between the powder and the plug must materially deadens this shock, it was clear that if the plugs proved successful, our principle must be wrong, and hence it was thought desirable to make a trial of the plan. The little parabolic gun on the table was also fired for comparison. Seventeen series were estimated by eight observers, and gave the following results:—

A. Cast iron parabolic gun. Charge, 4 oz. Papier Maché wad	1·00
B. Bronze 12-Pounder Mortar. Charge, 5 oz. (Service charge), wood plug	2·69
C. Bronze 12-Pounder Mortar. Charge, 5 oz. (Service charge), junk wad	2·31

Thus every observer placed the parabolic gun first; and not only was this the case, but it was observed during the experiment that the difference between the loud report and the two low ones was greater than had been the case at any of the previous experiments. The mortar fired with the wooden plug was rather less effective than the mortar fired in the usual way with the junk wad.

Since the parabolic gun combined all the points considered advantageous, such as the best material, length, calibre, shape of mouth, and wad, while the bronze mortar departed from these conditions in all respects, it was satisfactory to find that theory in this case was amply borne out by practice.

Thus far the experiments in this great question have been carried up to the present moment, and I have to thank you most heartily for the kind attention you have given to what has, I fear, been a very dry summary of bare fact. Much remains to be done, the preliminary trials on a small scale have but shown us in what direction to proceed, larger ones will no doubt be instituted; the best combination of effi-

[1] I have since ascertained that the wads used with the 24-pounder were slightly loose.

ciency and economy must be found; whether it will result in the triumph of guncotton or powder none can tell. It has proved a most pleasing task to aid the Great Corporation of the Trinity House in their endeavours to save human life, and perhaps our small share in this effort may be held to atone in some measure for our persistent endeavours to destroy it.

I feel sure you will all join me in wishing success to the Elder Brethren, though I fear it will be long before they persuade us to turn our swords into ploughshares and our guns into fog-signals.

NOTE.—For the experiments which illustrated and enlivened the lecture, the audience and the author owe their best thanks to Dr. Tyndall who lent the apparatus, and to his assistant, Mr. Cottrell, who worked it. Thanks are also due to Professor Barratt, of Dublin, for several valuable suggestions.

FOG-SIGNALS FOR VESSELS UNDER WAY.

By Staff Commander JOHN CUMINS RICHARDS, R.N., Hydrographic Department, Admiralty.[1]

FOG signalling as affecting the sailor, may be divided into two branches, namely, signals from an apparatus on shore, which apparatus is usually in connection with a lighthouse; and signals between two approaching vessels. In the paper read by Admiral Collinson on the 7th instant, and in the one this evening by Major Maitland, we have had an account of the experiments made, to determine what are the best instruments for producing a sound which shall most certainly warn the sailor of his approach to certain fixed dangers. In the present paper, I shall endeavour to state as shortly and concisely as I can, a few ideas on some means which may be employed by vessels under way, to lessen the chances of their collision.

During foggy weather, signals are of far more consequence than at any other time; but the difficulty of signalling is then increased, as sound is the only resource available. It is true, the flash of a gun is, to a certain extent, perceptible through a fog, but guns, however useful they may be as shore signals, cannot on board ship be relied on for the flash.

The present regulations provide that during fogs, steam-vessels shall go at their slowest speed, and shall sound a whistle not less than once every five minutes: sailing vessels shall sound a horn. These directions are admirable for their brevity, but it has long been felt that a system was required whereby a vessel's intentions might be indicated. This feeling has produced inconvenient and sometimes dangerous diversity of custom. In America, a custom has obtained whereby an approaching vessel gives notice of her intentions in the following manner: one blast of the whistle means, I am altering course to starboard; two, I am altering course to port; three, that a

[1] Read at the Evening Meeting, on Monday, May 17th.

vessel approaching or crossing is threatening a collision. This systen is perhaps the one most extensively used, as it is compulsory i American waters, but it is only suited for partial use in narro channels.

Of the various systems of ships fog-signals which have been pro posed, some may be mentioned as deserving notice; first, we have ha many imitators in sound, of Morse in telegraphy—long sounds an short sounds combined in various ways; but such a system is open t the grave objection of determining by so many operators on the steam whistle, what is a long, and what is a short sound: such nice distinc tions of time are more suitable to the trained hands of a telegrapl clerk. However valuable Morse's notation in light may be, a exemplified in Colomb's flashing signals, we may, I think, dismiss it application from the sphere of sound.

An ingenious and yet simple code of fog-signals for vessels unde way, has been devised by Mr. H. C. Rothery, Registrar of the Higl Court of Admiralty. Briefly stated, that code provides that steam vessels shall use a whistle, sailing vessels a bell: each vessel o becoming aware of the approach of another vessel, shall intimate b sounds of the whistle, or ringings of the bell (up to four in number the direction in which the sound is heard, and then act accordingly this method, however, fails in not providing for a distinct utteranc of the signals, inasmuch as the duration of the sounds, and of thei intervals, is not considered: also the substitution of the bell for th fog-horn in a sailing vessel, materially interferes with the existin regulations.

The fundamental idea of the system of ships fog-signals which am about to propose, is of two distinct sounds, and for this it will b necessary that all steam vessels shall be fitted with two whistles, on of which shall give a shrill sound, the other a deep or bass sound The only extra fitment required for the second whistle, would be a branch from the pipe which supplies the present regulation whistle By some of the combinations of which these two sounds are capable a code of signals is arranged.

The shrill whistle shall be marked No. 1 and painted green.
The bass whistle „ „ No. 2 and painted red.

All steam-vessels shall make known their presence by a prolonge shrill whistle of not less than ten seconds' duration: but for th purpose of signalling, the sounds from both whistles shall be given in short blasts of three seconds duration, with an interval of thre seconds between each blast.

Between each complete signal, a rest of at least ten seconds shal occur.

For greater clearness and to attract the eye, the shrill sounds ar denoted in the following table by green strokes, and the bass sounds by red strokes, corresponding with the colours of the whistles. With the exception of the warning signal, which is of not less than ten seconds' duration, each stroke represents one blast of three seconds' duration.

Signal Table for Steam-vessels.

Prolonged shrill		———————	Warning signal.
Signal No.	1, or	—	I am keeping on my starboard side of the channel.
,,	2 ,,	—	I am keeping on my port side of the channel.
,,	11 ,,	— —	I am altering course to starboard.
,,	22 ,,	— —	I am altering course to port.
,,	12 ,,	— —	I am steering North.
,,	112 ,,	— — —	,, ,, N.E.
,,	121 ,,	— — —	,, ,, East.
,,	122 ,,	— — —	,, ,, S.E.
,,	21 ,,	— —	,, ,, South.
,,	211 ,,	— — —	,, ,, S.W.
,,	212 ,,	— — —	,, ,, West.
,,	221 ,,	— — —	,, ,, N.W.
,,	1212 ,,	— — — —	My engines are stopped.
,,	2121 ,,	— — — —	I am going astern.

The bass whistle is almost universally used in America, and produces a very penetrating sound: the shrill whistle is the one most commonly used in this country.

Sailing-vessels.—All sailing-vessels shall use two fog horns, one of which shall sound a high pitched or tenor note, and the other a deep or bass note. The tenor horn shall be marked No. 1, and painted green; the bass horn No. 2, and painted red.

Signal Table for Sailing-vessels.

Signal No.	1 (warning)	———————	I am on the starboard tack.
,,	2 (warning)	———————	I am on the port tack.
,,	111	— — —	I am close hauled on starboard tack.
,,	222	— — —	I am close hauled on port tack.
,,	11	— —	I am altering course to starboard.
,,	22	— —	I am altering course to port.
,,	12	— —	I am steering North.
,,	112	— — —	,, ,, N.E.
,,	121	— — —	,, ,, East.
,,	122	— — —	,, ,, S.E.
,,	21	— —	,, ,, South.
,,	211	— — —	,, ,, S.W.
,,	212	— — —	,, ,, West.
,,	221	— — —	,, ,, N.W.
,,	1212	— — — —	I am hove to.
,,	2121	— — — —	I am tacking.

Sailing-vessels shall make known their presence by a prolong blast on the tenor horn if on the starboard tack, on the bass horn on the port tack. But for the purposes of signalling, the sour from both horns shall be given in short blasts of three secon duration, with an interval of three seconds between each blast.

Between each complete signal a rest of at least ten seconds sh occur.

It will be observed in these Tables that the distinctions of t whistles and horns correspond with the colours of the side-ligh thus the horn which is blown for the starboard tack is coloured gre and that for the port tack is coloured red.

A vessel having heard the warning signal of an approaching vess shall signalize her movements or course, which signal shall be answer by the other vessel making known her own course. Guided also the direction whence the sound proceeds, each vessel will have so important knowledge by which she will know how to act. F example, a steam-vessel, A, steering north, hears the whistle of a vess B, on the starboard bow. B is steering N.W., and makes the sig 221. A then knows that B on her starboard side is crossing her tra and threatening collision. By the rule of the road, A will keep out B's way; this she can best do by stopping or by going astern, having wisely made the signal 1,212 (my engines are stopped), keeps on her way. Although the latter, during clear weather, wou by the rule of the road be entitled to keep her course unaltered, y during fogs, both should stop, if necessary, in order to avoid collisi for it may happen that one may misunderstand, or may not hear t other's signals.

Again, A and B each hear a whistle ahead, both vessels will alt course to starboard and make the signal 11. In buoyed channels, t is perhaps the most common case to deal with during fogs, as it probable that all steam-vessels will be found keeping on that side the channel which is best marked, and carefully picking their w from buoy to buoy.

As regards the signals for sailing-vessels, I apprehend the use two horns offers many advantages, as indicating at once which ta an approaching vessel is on, and with a little practice the other sign might be readily and precisely made, thus removing one of the chi difficulties which has to be contended with. Those who saw and hea the powerful fog-horns which were exhibited by Admiral Collinson illustration of his lecture, will not have much doubt as to the efficien of such horns.

Narrow Channels.—Turning to the Steam-vessels Table, it evident that the first four signals will at all times be useful to vess under way in narrow channels, and will greatly assist in carrying o as in the River Mersey, some recent regulations, which oblige each vess to keep on her own starboard side of the channel. Thus, for instance, steam-vessel intending to cross to her port side of the channel, woul if another steam-vessel were approaching, sound two blasts of t bass or red whistle, signal No. 22; and the other vessel, if willing yield her side of the channel, would reply by making the same signa

but if she were unwilling, would answer by one blast of the shrill or green whistle, which means, I am keeping, or wish to keep, on my starboard side of the channel.

Fleet Evolutions.—The advantages to be derived in fleet evolutions, from the flexibility of the system now proposed, will be apparent. A squadron might, with perfect ease, signalize not only the course steered, but spell out words by means of the whistles or horns. With sounds taken two together, four signals can be made, three together, eight, four together, sixteen, twenty-eight in all. The single sounds may be used to determine whether the signals shall be numeral or alphabetical, that is supposing an alphabetical table to be arranged; and in such practice, where the attention is riveted, the sounds, as also the intervals between the sounds, may be made shorter. With sounds taken five together, thirty-two additional signals can be made; but by using the alphabetical notation, it is not likely that more than twenty-eight will be required.

I will now notice a few objections that will probably be made to the system proposed. The objection most commonly raised is, that we have not in our steam-vessels whistles sufficiently powerful to answer for purposes of fog-signalling. It must be admitted that, as compared with those of American steamers, our whistles are very poor in sound; this is probably owing to the fact that we have less use for fog-signals in this country than they have in America. But the more immediate cause, in many instances, is the want of sufficient steam pressure to blow the whistles. I say in many cases, because the almost universal adoption of high-pressure boilers in the mercantile marine, and the gradual adoption of the same in our vessels of war, has much reduced the number of vessels having low-pressure boilers. The engines of most of our ocean steamers are worked with a pressure of 60 lbs. In the Royal Navy, the engines of the "Malabar" and "Jumna" (Indian troop-ships), and of many other vessels, are worked with a similar pressure.

According to the observations of Sir Frederick Arrow, the 10-inch steam fog-whistle of the Manicouagan light-vessel, St. Lawrence river blown by 65 lbs. pressure, was heard at a distance of fully six miles; the fog-whistles of the United States are blown usually by 55 lbs. pressure of steam.

In the face of these facts, it may reasonably be assumed that we could have in most instances at our command on board ship, whistles of sufficient power for signalling purposes. Whistles, 9 inches in diameter, are already in use on board some of our vessels of war, but they are blown by a pressure of only 20 or 30 lbs.—a force insufficient for the purpose of producing a loud sound.

But by far the most powerful objection which will be raised, is the fact that, in the case of two vessels meeting and blowing fog-signals, it is difficult to tell by the unaided sense of hearing whence the sounds proceed. This objection is supported by the experience of many competent navigators, the difficulty being assumed as inherent to the nature of sound.

"Sound," remarks Professor Tyndall, "is in all respects reflected

"and refracted like light," or, in other words, sound is thrown bac and bent out of its course by intervening objects, thus producin echoes and deflections. In this statement we have, I venture to thin a solution of the difficulty commonly felt; for the usual position of tl whistle on board a steam-vessel is within six or twelve inches of tl fore side of the funnel; this position, although a safe one, is no doul well adapted for producing echoes. Let the whistle be placed in suc a position as shall, after experiment, be found best suited for soun and then we shall have a trustworthy fog-signal. "The ear, whe "undisturbed by echoes, becomes, with a little practice," according the observations of Professor Tyndall, "capable of fixing with gre "precision, the direction of a sound."

Having stated the most important objections that can be urg against ship's fog-signals, I will conclude with the hope that su signals may be considered worthy of experiment on a fitting scale.

The CHAIRMAN: The meeting will regret very much that Professor Tynd himself has not been able to be present. It would have added greatly to the inter of a meeting already interesting. And now if any gentleman has any remarks make, we shall be very glad to hear them.

Captain Sir FREDERICK ARROW, Deputy-Master, Trinity-House: You have be good enough, Sir, to invite some remarks upon the question before us to-night, a I hardly think I should do right in remaining silent after the interesting pap which have been laid before you; and also after the great skill, care, and attenti brought to bear upon this question of fog-signalling by the Ordnance Departme of the Royal Artillery. I am hardly perhaps capable of following so closely I should like to do, Major Maitland's admirable sketch of the operations they ha performed, but I think it will carry home the conviction, as Major Maitland hims said, that we are on the high road to success. I lay very great stress on the fa that after these experiments with small charges, and the comparisons of t experimental guns adapted to the small charges, it seems probable that they w work out satisfactorily on the larger scale with the charge we use ourselves, vi 3 lbs. of powder. I think there is no doubt at all that the short howitzer patter with revolving chamber made upon the principle Major Maitland describ will not only be a very great relief to the men who have charge of it, but will gi an amount of safety which has never yet been secured without a lengthened interv of time between the discharges. The limit of the interval of time should certainly under a quarter of an hour, and in that direction alone it is a gre advantage to know that by means of this rotating chamber we shall be able to repe the sounds much oftener. Turning back to the experiments to which I have mo directly had my own attention directed, viz., those carried out by the Trinity Boa under Dr. Tyndall's guidance, I believe they have produced results of the greate importance, and I must say that the thanks of the world are especially due Dr. Tyndall, not only for those results, but for the admirable way in which th have been demonstrated so as to carry conviction along with them. I venture say that although some of the results are in entire opposition to all previo philosophic theories as to sound, it is characteristic and shows the courage of tl man that he did not hesitate after sufficient proof boldly to enunciate new principl which have since been attacked. One of the chief advantages of Dr. Tyndall assistance, in addition to his scientific knowledge, was the extraordinary care a patience with which he pursued his investigations. Not once was anything le to chance. Every experiment was followed out, worked through, repeated ov and over again until conviction was certain to his mind; and I feel sure dealing with so difficult a subject, such a method was invaluable. With regard the general question of fog-signals, many theories have been expressed during t last few days after the unfortunate shipwrecks which have taken place, but I m remind you that it is not always that you can put theory into practice. Moreov

in the remarks that have been made upon the loss of the "Schiller," it has been said over and over again that if there had only been telegraphic communication from the lighthouse to the shore, many lives might have been saved. To my mind, such a view is an absurdity. It is not anybody's business to lay a telegraphic wire, except as a speculation, which can be made to pay; but even supposing it could be made to pay, there is no room in such a confined place as a rock lighthouse for the apparatus, and then the men have their other duties to perform, and if in addition to that they are to be telegraphic signalmen, to have charge of guns and guncotton, or any such explosive fog machinery, it would simply wear them out and interfere with their keeping their lights in proper order. Every rock light to a certain extent must be circumscribed in its area, its very strength depends upon it; the chief feature in such a structure is smallness, combined with solidity and great weight. In such a place you have isolated three men, three men who have much anxiety and responsibility, who have only a short period of rest at a time, and if additional duties were put upon them it is quite likely that they would break down. I heard the fog lasted, in the case of the "Schiller," something like three days off and on. Fancy the anxiety of these men if they are to be giving signals every five minutes during that time; and if they had had powder and guncotton it would have been extremely dangerous. I do not think the lighthouse authorities would be justified in allowing them to be placed in the lighthouse, because the loss of the lighthouse itself might follow from the fact of having these dangerous explosives fired, and stored in such quantities as would be necessary. I am quite certain the fog-signals will be an unmitigated boon and blessing to humanity. Nothing in all my experience as a seaman has ever given me so much care and anxiety as the fact of being in a fog. We know what bad weather is, what heavy seas are, those dangers we can see and face; but in a fog, dangers may be about us but they cannot be seen, and the anxiety increases the longer the fog lasts. In reference to the matter, Commander Richards has turned his attention to what is of very great value, namely, signalling for ships under way, but I venture to say it will be a very great mistake whenever we get into what I may call a simply theoretical line. There are many classes of seamen. The officers of Her Majesty's Navy, the officers of the great steam-ship companies, and the officers of many sailing ships are men who are intelligent, trained observers, but they do not constitute the great bulk of the people who follow their vocation on the water. The idea that has always been acted upon in the Trinity House is that safety is wanted, not for the intelligent men, but for the unintelligent; and if we sanction a code of signals which is beyond the comprehension of the most stupid of our seamen, we are going out of our path, and are inviting disaster. Our efforts should be as far as possible, while we accept all the improvements of modern days, to put them within the comprehension of everyone; and, therefore, when I am told we should depend upon these different pitches of sound and depend upon a code, then I would ask, are those proposed distinctions, and is that code, things which everybody can understand? I am quite sure every intelligent man would understand them and appreciate the efforts of Commander Richards, but at the same time a great many will think he has gone too far. I am inclined to that view myself, and I think in his proposals he goes beyond the point of absolute safety. I am not inclined, as far as my humble judgment goes, to see us step out of that straight and simple line which we know will produce good results; and, therefore, when I see it proposed to apply all these improvements of modern days, all the refinements of fog-signals and sounds, in such a manner as will tend, in my opinion, to encourage carelessness in navigation, I feel that we are better without them. Look at the unfortunate "Schiller;" if the captain had followed the good old practice of seamen, and had used his lead and put his head right away from the coast he would not have lost his ship. *De mortuis nil nisi bonum;* but, at the same time, I cannot help thinking if that ship had been sailed upon the true old principle of making sure, the disaster never need have happened. But, unfortunately, there is a struggle to be always first (a very right thing to a certain extent), to which I should be the last man to object, but then that, unhappily, leads very often to want of care and consequently loss of life. Now if this ship had not been poking into Scilly, which every seaman ought to avoid in almost any weather, especially in a fog, she would have been safe. He simply wanted to telegraph to his agent at Plymouth to ge

him coals, and to telegraph on to the continent, and for that he ran the mos frightful risk. There is no doubt, because it is as well known to every one as it i to a sailor, that you may take a ship into the English Channel by means of the leac just as if you were reading a book. A more fatal calamity brought about by wan of careful attention I think I never heard of. In this case I do not simply say t people—practice what I preach, because I myself have practised it, and I can safel say I have come in a sailing ship all the way up the channel more than once, withou ever seeing an atom of land or knowing where I was, except by means of the lead the whole way up to the Downs. If that could be done then, and I am speaking o more than twenty-five years ago (since which time I have not commanded a ship), wha ought to be done with modern appliances? No, they forget to make the best us of modern appliances, and they run these frightful risks for the sake of some littl gain. It cannot be impressed too strongly upon the community at large tha human life is worth more than money, and in this case no money can possibly repa the loss. With regard to fog-signals generally, I would only say as a matter o information to the audience, although they have been very well informed by wha Admiral Collinson put before them the other day, that the Trinity Board have mad a great stride in fog-signals; not that I mean any great advance from one point t another, but from this knowledge, that fog-signals can now be made useful at certai distances. The fallacy, and the fatal fallacy which the Americans and the Unite States Government, also the Canadian Government, have promulgated, was to sa that fog-signals could be heard at the longest ranges possible, instead of saying tha they could be heard at the shortest ranges. When I was in Canada I pointed i out to the authorities, but I have not seen any practical result. At the same tim I hope to see them before long, for it is a mere delusion to tell a man he can hea a signal fifteen miles off, after these admirable experiments, and the report o Professor Tyndall, in which he demonstrates, as plainly as words can say, tha except under the most favourable circumstances no man ought to trust to a fog signal more than two or two and a-half miles to make perfectly safe. Acting upo that, and with the knowledge that the denser the fog is, apparently, the better th results you get, then I say a fog-signal is of real value when it is known that unde all circumstances it may be heard at a minimum range of two to two and a-hal miles; and we have gone further than that, because we have made a rule that if danger extends more than a mile, or a mile and a-half beyond the spot where a fog signal can be placed, we will not venture to put it there, because ships must hav room to get about and manœuvre. An instance of that occurred the other day a Heligoland. The Trinity Board were very much pressed to put a fog-signal a Heligoland, and very useful it would have been if we could have insured its bein always heard at a distance of three miles. But we could not do that, and soone than give a delusive warning, we made up our minds not to give any at all. Ther is a great inducement to us to proceed in the path in which we are now advancing and I hope the day may come when we may get sound very much more certainly a greater distances, then we may do that which we cannot do now. As an instance o the caution which I consider ought to guide all administrative bodies that have s much at stake, I would say that our motto is to keep within bounds, and never t promise a thing that we cannot perform.

Captain Close, Trinity House: There is one point I should like to see made a little more clear. The papers have stated that it would be a great advantage t have telegraphic communication between the lighthouses and the shore, and tha has been taken up very much by firms in the city. The great question is, what use could have been made of those wires if they had been there? They were aware a St. Mary's, Scilly, by the fishing boats and boats from the wreck, that a vessel had been wrecked, and it was only some hours afterwards that the fog cleared off sufficiently for the people of the lighthouse to see that the ship was lost, and no help could have come by means of the wires. I mention this, because the public pres of London have very largely advocated what I believe would be utterly useless, and I think, generally speaking, nautical men are very much of my opinion. There might be cases in which a report could be sent when a ship was wrecked at the lighthouse itself, but very little use could be derived from it.

Admiral Sir Henry Codrington, K.C.B.: In all that Sir Frederick Arrow ha

said, I think I fully join. With respect, first of all, to the manner of signals, I quite agree it would be a dangerous thing to introduce the signals brought forward by Commander Richards amongst a seafaring population generally; but I should be glad to see something like it in the Royal Navy. I think it would be of use there; but I should be very sorry to see it introduced generally among the whole of the maritime population. Turning to these various means of producing sound (fog-horns, guns, &c.), it seems to me we have not got the best shape even now. I do not think even the best of them is the right shape for our purpose. In our lighthouses, which are so admirably fitted and served, we have the most excellent plan of utilizing all the rays of light which would otherwise be dispersed, either above or below; that is to say, we use the glass prisms, and every ray of light is utilized, so that in whatever direction a vessel comes she is sure to see the fullest power of that light. But what is the case with all of these sirens, fog-horns, and guns? Unless a vessel approaches in the full front of the siren or trumpet, she does not get the warning she ought to get. It seems to me we should treat sound somewhat in the same way as we treat light, that the sound should be reflected horizontally and dispersed somewhat on the same principle, not the all-round principle as in these steam whistles, but that we should disperse it equally from one side to the other of the requisite horizontal angle, from starboard to port as it were, simultaneously; and, moreover, lose none of it upwards and none of it below. But as it is, every one of those appliances that I have seen, whether steam whistles or those that I now see before us, can only give a very limited area of sound, either in extent or in horizontal plane. I should be glad if invention would give us something better by widening the mouth of these fog sirens or guns, horizontally, so as to give as full a sound as possible in each direction contained within the angle required for warning. We should want it on that side, we should want it on this side, and it should be what I might call an equalizing sound, so that none should be lost above and none below, nor to the right or left beyond the required angle. I do not see that we have got that in any of those, and that is a principle I should very much like to see.

Captain Harry Brent, R.N.: I am afraid I quite disagree with Staff-Commander Richards as to the shrill and the deep sounds. The deep sound is heard much further than the shrill, and when you come to a question of notes, people will differ almost as much as they will about colour. In lights you will find many people will not agree as to colour, and you will find people will not agree about notes. Experience has taught us that the shrill sound is not heard so far as the deep sound; therefore there may be times when you only hear the deep and not the shrill. The lecturer said it would not do to rely upon long or short sounds, because you could not tell the difference. The experience of our fleet is, that we can make that distinction, and the ships can hold communication and tell one another their whereabouts in a fog quite easily, the only limit to the signalling being the distance. I should think it is quite possible, as a siren is better than a steam whistle, that we might have sirens for the service of the fleet. Captain May, of the "Northumberland," did something of the same sort; he filled the steam launch's engine with air, and fitted to it a fog horn, which answered very well indeed. I think it is quite within the bounds of possibility that inventors might devise for our ships a small siren with a small air pump, so that you could fill a chamber and make your long and short flashes. The system of the long and short flashes being used in so many ways is much better than loud or shrill or deep sounds; you use it in everything, and people are accustomed to it—certainly everybody in the service. I am in hopes that the fleet may be furnished with some gun with which to signal. Officers are placed in great difficulty to know the best gun to use in the fleets. The Channel flag ship has had sometimes to clear away all one side of her battery in case of making signals, and if these small guns give such good results, one hopes we may have something of the same kind supplied to our ships, certainly to our large ships, on purpose for fog-signals forming part of our system.

Sir Henry Codrington: I have had something to do with using guns for fog-signalling, but there was always very great difficulty, and there always will be, in trusting to guns for fog-signals, unless there is a small gun which may be placed in a definite position in each ship. Sometimes a gun is fired on the starboard side, and it will give a very different sound from a gun fired on the port side; therefore, if

we are to trust to guns for fog-signals, we should be much rather content with having a small gun for fog purposes placed in a definite part of each ship, so that each gun fired for fog-signals might give the same sort of note, not as different as it sometimes is, according to the locality in the actual ship herself.

Mr. STIRLING LACON: I desire to point out that in crowded thoroughfares such as the river, or the Swin, hundreds of vessels may be at anchor, others tacking, and steamers passing in and out among them. Any person who has been in a fog under such circumstances must be aware how confusing are the sounds of bells, fog-horns, and steam whistles, and how impossible it is to judge precisely the direction these sounds come from. I think, therefore, it would not be practicable to carry out a series of telegraphic sound signals of the nature proposed by Captain Richards.

The CHAIRMAN: I should like to ask if the observations on the several sounds (by small guns of different forms) were taken at the same time, that is, if the observers were all employed at different distances at the same time?

Major MAITLAND: They were taken by one party of observers who varied their distances and they were all together.

The CHAIRMAN: I think more interesting results would have been obtained if parties had been at different distances on the same day.

Major MAITLAND: We should not have got the averages.

The CHAIRMAN: I understand from Sir Frederick Arrow that there is no advantage in the signal being heard further than *two* miles, or that a law must be laid down that all signals are not supposed to extend beyond that.

Sir FREDERICK ARROW: It was that you should not lead people to expect more than you could at all times perform.

The CHAIRMAN: The difficulty of that is evident because you have a signal that may be heard fifteen miles.

Sir FREDERICK ARROW: I mean, if a man expects to hear a signal five or six miles off when, by the state of the atmosphere, he cannot hear it more than two, that is a positive evil.

The CHAIRMAN: He is to assume on all occasions it is not more than two miles?

Sir FREDERICK ARROW: He should not attempt to guide himself except within the minimum range.

The CHAIRMAN: I think with regard to guncotton the question of cheapness should not be taken into consideration in an important matter like this. The question is one of storage room rather than of expense. I will now ask Major Maitland to offer any observations he has to make in reply.

Major MAITLAND: If you take the same price, you can take more powder and make more noise than with the guncotton. It is very well to say you can employ guncotton, which will cost still more, but then you can take more powder at the same cost and make still more noise. At Lundy, during 507 hours of fog in 1873, they fired about every quarter of an hour. When we fire every five minutes, as we hope to do, that will be 6,000 times from one gun. I do not know how many guns they are going to put round the coast, but supposing it to be 100, that would be 600,000 rounds, or, at 2*s.* a round, £60,000. Therefore, price has something to do with it. Sir Frederick Arrow has very kindly made some remarks about the efforts of the Royal Gun Factory. I am sure I may say for Colonel Campbell and myself that it is the greatest pleasure to us to work with the Trinity Board—they treat us so well and accede to our suggestions so readily. Admiral Codrington mentioned that he wished to disperse the sound in a horizontal direction, to go sideways and not above or below. I think that would be a very good plan, but I do not know that we could give you the mouth of a gun that would do it: it is purely a mathematical question. The parabola sends the sound straight forward, but I do not know any curve at this moment which would send it out in the direction Admiral Codrington wishes. I do not think there is such a curve; still there may be, and we will try and work it out. I think that is all I need say with reference to the points raised in the discussion.

Commander RICHARDS, R.N.: Of the several objections made this evening to the propositions that I have started, I will notice the most important one first, and that is about the difficulty of using such a system in crowded navigation. In theory that is a very powerful objection, but in point of fact it is a very small one. On the

coast of America there is an enormous coast traffic, and it is well known that vessels there run full speed regardless of fog. When they have run their estimated distance, they stop, blow the fog-signal, and confidently expect to hear one from the shore, and so they go on amidst a large number of ships. That fog-signals are required is evident from the fact that the Americans have introduced them; signals, perhaps, not quite so complex as those now proposed, but, as I have pointed out, their use is very small. The reason I have proposed two distinct sounds is to give sound-signals a larger scope of usefulness. It is quite possible that in fogs the whole of those signals might not be required. Take, for instance, the steam-vessels signals: the probability is in narrow channels, where navigation is most crowded, only the first four signals would be required, and perhaps the last two. As regards the long and short sounds for signalling purposes, I must differ from Captain Brent. I think there is liable to be great confusion, whereas with my system you have simply to tell the man "Blow two green and one red," &c. I do not mean to say that this system is perfection, but I hope it will have a trial. We have no system of fog-signals in this country for vessels under way; every system that has been brought forward has been put aside owing to the various difficulties which I have stated. I hope I have successfully disposed of those difficulties. Sir Frederick Arrow made a remark that we should have a code that everybody could understand. I may not have been very clear in my explanation, but I think if the list of signals were printed and hung up in the wheel-house, being, as it is, a sort of coloured picture, it would soon be mastered. I quite agree that it would be inadvisable now to introduce such a system generally: the matter requires consideration and experiment. It has been said this evening, during the discussion, that deep sounds can be heard further than the shrill. Authorities are divided on that subject. I know the Americans have that opinion, because all their whistles are of deep tones; but a very general impression prevails amongst many people whose opinions are entitled to weight, that shrill sounds are most penetrating. What we require is a series of experiments carefully carried out to decide these disputed points.

Major MAITLAND: There is one point I omitted to mention. The gun is supposed to be turned round and to fire in any direction you follow, so that you get the longest possible reaching sound in every direction, and dead to windward, too, if preferred.

The CHAIRMAN: It now devolves upon me to offer the thanks of the meeting to the gentlemen who have so ably brought this subject before us.

Evening Meeting.

Monday, May, 31st, 1875.

VICE-ADMIRAL SIR FREDERICK W. E. NICOLSON, BART., C.B.,
Vice-President, in the Chair.

NAMES of MEMBERS who joined the Institution between the 18th and 31st May, 1875.

ANNUAL.

Thomson, C. F., Captain 7th Hussars.
Lambert, Walter M., Lieut. R. M. Artillery.
Maltby, J. M., Lieut. 1st W. I. Regiment.
Auchinleck, Wm. L., Captain 53rd Regiment.
Lloyd, Thos. F., Lieut.-Col. 98th Regiment.

A NEW SYSTEM OF NAVAL TACTICS.

By Lieut. GRAHAM BOWER, R.N.

THE subject which I have the honour to introduce this evening is one that during the last few years has received considerable attention from the Naval Officers of all maritime Powers.

Despite, however, all that has been written and said on the subject, no definite conclusion seems to have been arrived at, and our Navy is, at the present moment, without any certain idea as to the system of tactics that it would be called on to pursue in any future naval action. That this is the case I imagine is a good deal due to the fact that we have been too much in the habit of studying tactics without considering the enemy; playing Hamlet, in fact, with the part of Hamlet left out.

The past history of the subject gives us but little information; our victories during the great war were few, if any of them, due to tactical skill, and for the causes that determined the result, we must look outside the field of tactics.

To the modern student of the subject this is no great loss, steam and armour-plating have so altered the conditions of naval warfare that there are few lessons deducible from the ancient battles that would be applicable to modern times.

The only great battle of our day, the battle of Lissa, is equally

meagre of information, having been lost by mismanagement rather than won by skill.

We have, then, as Commander Noel so well puts it, to trust to our imagination for our ideas of future naval battles.

But, nevertheless, our imagination is capable of affording us ample materials for arriving at a right judgment.

The manœuvres of an enemy are necessarily restricted to certain mathematical figures, and we can easily consider the formations it would be most advisable for us to assume to meet them.

We have at present in our signal-book two systems; one, that I will call the "division system," which divides the fleet into divisions, sub-divisions, &c., &c., and presumably proposes that the attack should be made either in extended, narrow, or deep and medium formations.

The other, the "group system," I shall assume to be well known to my audience, and to require no description from me.

At the time our signal-book was altered, to admit the former of these two systems, a change, and as I maintain, a change for the worse, was made in the system of evolutions. I allude to the flank movement, to which I shall shortly draw your attention.

These systems that I have spoken of have been built up on totally different principles to the system I advocate; my contention is, of course, that my own is right. It is important, however, to keep in mind the difference in principle. In the two existing systems it would seem that a system of evolutions has been constructed suited to the requirements of a fleet during peace, and from this, certain formations have been selected as advantageous for use on the field of battle. In forming my system, I have begun at the other end; I have asked myself what possible formations can an enemy assume; I have then asked myself, what formations would be most advantageous against them; and lastly, what are the evolutions necessary to their execution?

Now, in introducing a new system of tactics this evening, I feel that it is not sufficient that I should show that mine is good, but also it is necessary that I should show it to be better than those already existing.

This, then, must be my excuse for commencing my lecture with a criticism of the two systems I have spoken of.

I will here state briefly the manner in which I propose to divide my subject this evening.

(1.) To endeavour to show the weakness of the "group-formation" considered tactically.

(2.) To endeavour to show the danger of the so-called "flank "movement."

(3.) The fallacy of the attempt to confine the tactical formations to certain limits, necessitated by the organization of divisions.

Lastly, to introduce a system of evolutions, and of tactics, differing from the foregoing, and based on the definition of tactics, namely, an endeavour to manœuvre on the field of battle, so as to outwit and overcome an enemy.

I do not claim perfection for my system; we live in an age of pro-

gress, and doubtless, in time, a system will be found to defeat mine, but I do claim that it is better than any at present in existence.

If in the remarks I make in my paper I appear to criticise somewhat closely the opinions of those who have preceded me, I beg that you, and they, will understand that I do so in no carping or jealous spirit, but with the object we all have in view, viz., the elicitation of the truth on an all-important subject.

In considering the first portion of the task I have set myself this evening, namely, to prove the weakness of the "group system" as a tactical formation, I intend to take Commander Noel as its latest and most authoritative exponent.

The system has numerous other supporters, but, to consider and answer all of them, would be to waste the time of this meeting. Commander Noel has put the case as strongly and as clearly as the position admits of. He says—

"Groups once having been formed, the ships should not be changed, "the great object of groups being that each ship, by constantly holding the same place, will get to know its position and the movements "of its companions in the group; by this plan the comparatively few "manœuvres that are required when working in groups will be taught "to eighteen ships, in six groups, as readily as to six ships not grouped."

Again, quoting Commander Pellew, whose remarks are endorsed by Commander Noel:—

"This system of cutting up large fleets into smaller bodies, so much "more easily manœuvred, I consider to be of essential importance, "especially with respect to the facilities it affords for rallying or "detaching, and for keeping ships together at night."

Here, then, are special advantages claimed for groups. I will now put the other side, as it appears to me.

My objections then to this claim are as follows:—

(1.) The arbitrary resolution of a fleet into large tactical units restricts the mobility of the fleet, and limits the number of formations it is capable of assuming.

(2.) That it necessitates a permanent delegation of authority. That this is liable to end in desultory and irregular action on the part of subordinate commanders. That this irregular action can never produce the same result as perfectly harmonious and concerted action.

(3.) That this harmonious and concerted action can only be secured by the unification of command and responsibility.

(4.) That where a necessity arises for a delegation of authority, that delegation should cease with the period of its necessity, and should be granted to the person or ship so situated as to be in the most advantageous position for exercising it.

(5.) It is assumed that manœuvres would, on this system, be as easily taught to eighteen ships as to six.

I can see no greater difficulty in teaching manœuvres to eighteen ships than to six whatever system we adopt. Group-leaders have no special monopoly of intellect that I am aware of.

(6.) The merit claimed of accustoming ships to work together in a group, I maintain to be in reality a defect.

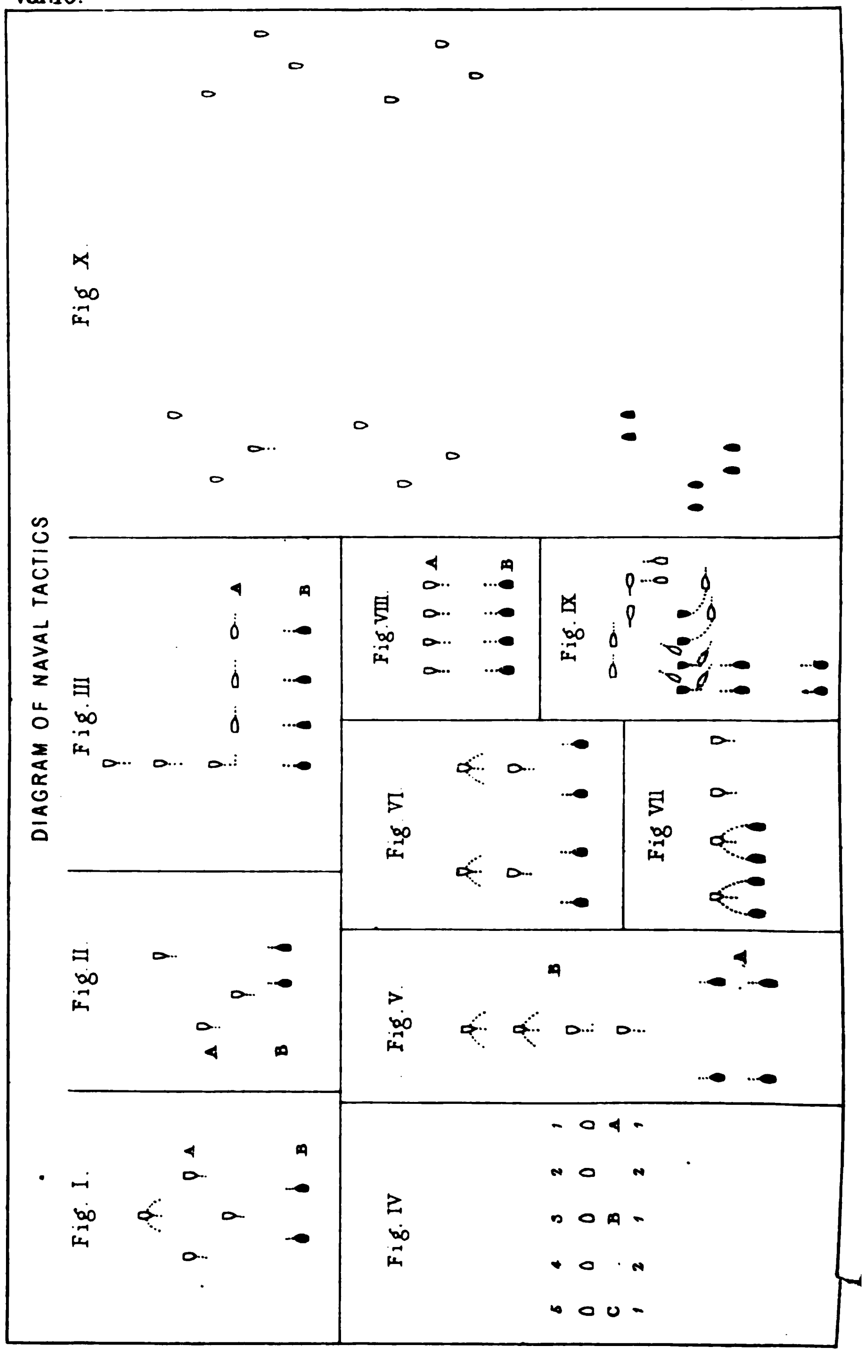


DIAGRAM OF NAVAL TACTICS
Fig. I.
Fig. II
Fig. III
Fig. IV
Fig. V.
Fig. VI
Fig. VII
Fig. VIII.
Fig. IX
Fig. X

J. Jobbins

It will not have escaped the notice of my hearers that soldiers are discussing the propriety of accustoming men of different regiments to work together in a battalion or company. Now in forming permanent groups we are, if I may use the word, unaccustoming ships to work with other ships of the fleet.

(7.) To borrow another illustration from the Army, we are, in forming groups, creating a front and rear rank.

I need hardly point out that the establishment of a permanent front and rear rank would be a sacrifice of mobility; yet in groups we are creating precisely the same things.

Commander Noel quotes Captain Colomb's remarks on angular formation.

He, Captain Colomb, says:—

"In my former paper I endeavoured to point out that, however "valuable in theory this angular formation might be, it was so un- "wieldy and difficult to maintain, that practically it was valueless."

One would hardly expect an advocate of group-formation, to quote such an emphatic condemnation of angular formation, with approval, yet such is the case.

I can only say that my own experience convinces me of the truth of Captain Colomb's remarks, and of its application to all angular formations, groups included.

(8.) I again quote Commander Noel on groups. He says:—

"Having headed towards the enemy, there are, I think, when work- "ing in groups, only two formations in which to place the fleet for "attack.

"Groups in columns of two divisions in line-ahead, and groups in "line-abreast."

Now if this be the case, groups can certainly not claim to be a tactical formation at all. It would certainly require an unusual amount of imbecility on the part of an enemy to place him in a condition unready to meet an opponent whose stock of tactics, prepared to outwit and overcome him, is limited to two formations!

(9.) One last merit claimed for groups requires consideration, namely, that they afford means of rallying. Now let us examine this; let us suppose a fleet to have passed through an opponent's line, and that one of the groups has lost two ships, another one disabled, not a very improbable case surely; yet, if the Admiral intends to turn and renew the charge, he must reorganize his fleet anew before doing so.

(10.) The last, and perhaps, most fatal objection to groups on the ground of principle, is, that they necessitate the use of compasses in action. Now from the time the first shot is fired in a naval battle compasses are useless, and a system requiring their use must break down. This applies to all angular formations.

I now come to special objections against groups. Fig. I represents the original group of four ships attacked by a "pair" in lines-abreast.

The "pair" advance, empty their inside broadsides in exchange for the outside ones of the group-leader. Exchange broadsides with the wing-ships of the group, and then turning, together ram the rear-ship.

For this vessel there is absolutely no escape, not even in flight.

This particular form of group is now obsolete, and I only intend to use it here to illustrate a principle.

The ships marked (A) form the group, those marked (B) the pair.

Fig. II represents an attack by a pair, on a group formed on Commander Noel's system.

This group is formed in the following manner:—Ship (2) forms five points abaft the starboard beam of ship (1), and two cables from her. Ship (3) forms six and a-half points abaft the port beam of ship (1), and four cables from her, being then four points abaft the port beam of, and three cables from, ship (2).

The pair advance in line abreast, steering in such a manner that the port ship of the pair may pass close to and on the port side of the group-leader; the starboard ship of the "pair" steers in such a manner as to keep on the port bow of the rear-ship, and at the same distance from her as her consort in the pair.

Now on closing, the leader and port ship of the group exchange broadsides, the pair pass on, receiving another broadside from No. (2) of the group; when within convenient distance they turn together and ram the rear-ship of the group.

Now, in these two attacks on groups by an inferior force, the rear ship has in each case been selected for ramming; the reason being that her comrades are so placed as to be incapable of rendering her any assistance; indeed, I can see no possible means of escape for the third ship of the group; it would be too late for flight, once the pair have passed the leader; to turn towards one or other of her enemies would be to expose herself the more to the other.

I will now leave the subject of groups for a moment, and consider the defects and dangers of the flank movement.

This evolution was introduced when the new signal books were published in 1867, and is mathematically the shortest method of forming line abreast from line ahead; it has been adapted to most of the changes of formation in our signal-book, as, besides being the shortest method, it has the further advantage of not requiring any alteration of speed for its execution; as a peace-evolution it is unrivalled for simplicity and rapidity, but as the British Navy exists for other purposes besides peaceful reviews and exercises, so our signal-book should be formed to meet the conditions of war.

In Fig. III, I show a fleet endeavouring to perform the flank movement in the presence of an enemy. The fleet marked (A) is shown trying to form line abreast in presence of a hostile fleet marked (B), which is already in line abreast; the leading ships of (A) have turned, and have their broadsides exposed to the rams of the fleet marked (B); these leading ships have the choice of two alternatives, either to continue the movement and be rammed and sunk, or to turn towards their adversaries, thereby disorganizing the fleet of which they form part.

There are in our signal-books several blank spaces, left so, I presume, for the purpose of allowing a Commander-in-Chief to fill them up according to the requirements of the fleet. If such be the

intention, I can only say, nothing can be more mischievous. An Admiral's alterations and additions do not extend beyond his own immediate command; and were a squadron reinforced on the eve of an engagement, by ships from another station, there is no end to the disaster and confusion that might accrue from the fact, that different portions of the same fleet would be using different signal-books.

Another point to which I wish to draw attention is, that there is an idea afloat in the service, which I find expressed by Commander Noel and other writers, that before an engagement, an Admiral should hold a conference to determine his mode of attack.

Now, I ask, why put it off till then? if a conference be necessary, why not hold it now? an Admiral at sea is not likely to have any more information available than we possess on shore; surely we are as well informed as to the strength, and composition, of foreign navies now, as we would be at sea. A fleet should at all times be prepared to meet an enemy; there may not be time to hold a conference, and an Admiral on the eve of an engagement will have enough to think of, without the addition of a council of war, which, if we may believe a proverb, "never fights."

I now come to my own system of tactics; it requires a special system of evolutions. As it would be beyond the scope of this paper to go into all the evolutions in detail, I will content myself with indicating the leading points and principles on which the evolutions are based.

(1.) I accept it as a rule that, in every change of formation, the bows of all ships should, as much as possible, be kept pointed towards the enemy.

(2.) That during the period of the interlocking of fleets, an Admiral is unable to exercise any authority over the ships under his command, and that a delegation of authority is necessary.

I provide for this by arranging that, after the fleet has assumed its formation for attack, and when it has arrived within a distance of 1,500 yards of an enemy, it is to be considered divided into "pairs."

(3.) A pair consists of two ships, whose duty it is to act in concert, and direct their combined efforts to ramming the single ship of the enemy's formation, against which they may be directed.

(4.) The senior of two ships forming a pair need not necessarily direct the pair; the direction being assumed by the ship nearest the Admiral, as he is best situated to observe the Admiral's motions, and decide correctly.

Now here I am aware that I am introducing a principle contrary to all our ideas of discipline and subordination; but I am sure that, if I succeed in proving that it gives a tangible advantage, there will be few objectors to it. We have already in the service a rule, that an Officer from the flag-ship takes command, whatever his seniority; this is merely an extension of the rule, with more reasons to allege in its support.

We all of us, I imagine, understand, that during the period of the interlocking of two hostile fleets, the area of vision will be very

limited, and that if the senior ship of a pair be the farthest from the Admiral's, he is from the circumstances of his position, unable to assume the direction.

(5.) The organization of pairs ceases directly the fleets have "drawn the battle clear," and the ship becomes as she was at first, the tactical unit.

(6.) Every ship on joining a squadron should receive a fleet-number; this number would represent her place in line ahead, it should be kept continually flying at the main, and be liable to change on the fleet being ordered to "tell off."

(7.) A squadron has no permanent right or left, front or rear; the Admiral need not necessarily lead the squadron; the same rule applies to the placing of ships.

These are the principles on which the evolutions are formed; I now come to their application.

To meet the first of the seven requirements I have spoken of as essential to a system of evolutions, I would recommend the old-fashioned method in effecting any change from line-ahead to two columns, in forming line abreast, or increasing the number of columns, in fact, for every purpose for which the flank movement is now used. I imagine that most of my audience are already acquainted with this method, but for the benefit of any of those who have not practised it, I will give a short description, together with the modifications I would propose, in order to give increased mobility.

A squadron on assembling, would form line-ahead in the order of their fleet-numbers.

From line-ahead, to form two columns, the odd numbered ships turn to starboard, the even to port; on arriving in position, in column, the leader of the starboard column would hoist letter A, in addition to his fleet-number already flying, and the leader of the port column would hoist B, in addition to his number, the signal would then be made "tell off," and the ships would hoist numbers corresponding to their places in the column in which they might find themselves.

To double the number of columns would be to perform the same manœuvre, "telling off" afresh after each manœuvre is completed, and each column being lettered.

On arriving in line-abreast, which the ships must do if this signal be repeated often enough, the ships would "tell off" from the right, as in Fig. IV, the old numbers are placed below the ships, and the new ones above.

This, of course, would not be the ordinary mode of forming line abreast, which would be as follows:—

The ships, odd and even, steam to their places on right and left of leaders, when the signal is again made "tell off."

In all cases in line-ahead, ships would "tell off" from leaders.

In line-abreast from the right.

In quarter or bow-lines from the ship most advanced.

In angular formations there would be two Nos., (1); in the case where the vertex of the formation is in front, the ship at the angle, and the one on her starboard-quarter would each be No. (1).

In angular formations where the vertex is refused, the ships on the extreme right and left would each hoist No. (1).

The formation of pairs, when the fleet are in columns in line-ahead, would not necessitate any change of position on the part of any of the ships.

Ships flying similar numbers form pairs.

In line-abreast also, no change of position would take place, the pairs counting from the right.

In bow, and quarter lines, and in angular formations, a slight change is necessary, the ships flying the highest number moving up to take station.

In these (the angular formations) it would be necessary to make the signal "pairs," earlier than in other formations, in order to afford time for ships to settle in their places before closing the enemy.

Now the system of "telling off" after every evolution may be objected to, as causing a re-organization of the fleet after every manœuvre.

I will, therefore, give the reasons that induce me to recommend it:—

(1.) No re-organization takes place, the signal to "tell off" causes every ship to hoist a number, which number represents her place in line-ahead, and is an indication that she understands her duty in executing the next manœuvre; it would be quite possible to perform every manœuvre without "telling off," the system is, however, a precautionary one to prevent accidents or confusion.

(2.) As there has been no permanent organization, there can be no re-organization, the system throughout is one of orderly disorder, specially designed to meet the varying circumstances of a battle-field.

(3.) By thus constantly varying the position and duties of a ship, you institute a system which no accident on the field of battle can throw out; if one or more ships be disabled, and have to withdraw from the action, there can be no confusion or hitch consequent on their withdrawal.

(4.) It may possibly be asked, in connection with this system of telling off in fleet-numbers, how we would manage at night, and what substitute would be provided for the numeral flag kept constantly flying by day?

The arrangement I would advocate for this is a simple one. It would be obviously impossible to hoist a string of white lights to represent the number, and I would advocate the use of white, red, and green lights at night, the white light to represent the one, or letter I, in the Roman numerals; the red light, the letter V, or five; and the green light the letter X, or ten. By this arrangement we would be able to make numbers up to thirty-nine, with only five lanterns, the upper lantern representing the letter to the left; for instance, to make nine, a white light above a green one would be hoisted.

My time will not permit me to enter more fully into the system of evolutions. I will now come to the main object of my lecture, the new system of tactics.

Tactics.

The system of tactics which I now introduce to you is based the following principles:—

(1.) That the ram is the principal weapon of naval warfare.

(2.) That of two ships equal in every respect, and equally w handled, and each desirous of ramming his adversary, neither c calculate on success; but if two ships be brought against one, t single ship must be rammed.

These two principles, I imagine, will meet with few dissentien they may be accepted as axioms, and require no argument from i in their support.

The object I propose to myself, in this system of tactics is, in cases, to endeavour to bring two ships to bear against one of t enemy.

For this purpose, I would institute an organization of pairs.

This organization of pairs, as I have already explained, should merely a temporary one, existing for the time between reaching distance of fifteen hundred yards from the enemy, after formati for attack is completed, and lasting until the fleets have drawn cle To make it a permanent organization, would be to lessen the mobili of the fleet. For the same reason, also, the vessel on the side near the Admiral should direct the pair, irrespective of seniority. T Admiral's formation of attack should be dependent on that of l enemy. As a pair is intended to occupy the same space as a sing ship of the enemy, the fleet should be constantly exercised manœuvring, at high speeds, in close order.

Figure V represents an attack by a fleet, on an enemy in lin ahead, an instance of Captain Colomb's narrow front.

A and B are two opposing fleets; they sight one another in lin ahead. A should immediately form two columns; should B st remain in line ahead, A should continue his advance, steering such a manner that B may pass between his columns; when with fifteen hundred yards of his enemy, or within such a distance th a change of formation is no longer possible to B, the Admiral shou make the signal "pairs." From that moment, the ships in tl Admiral's line should assume the direction of the ship abreast them, in the other line, still however keeping station as accurately possible. On passing the van of B's fleet, broadsides would exchanged, the ships passing on, closing the columns as they do so.

On arriving within a convenient distance, the headmost pair tu together, and ram the rear-ship of B's fleet, the other pairs perforn ing the same manœuvre on the ships corresponding to the pairs.

Now, let us examine the position of the rear-ships of B's flee Should they attempt to turn towards either adversary, they expo their broadsides the more to their other opponent; unless the vesse of A's fleet have bungled their work, it would be too late for B's shi to attempt flight; the van ships are in a position that renders the unable to rescue their comrades.

In fact, unless this manœuvre be very badly executed, it cannot fa to be successful.

In Fig. VI, I have supposed that the opposing fleet have formed two columns. It will be noticed that in the figure there are but four ships in each fleet; this, therefore, may be taken as an example of Captain Colomb's formation of equal depth and front.

I wish to explain here, that although I have constructed the diagrams for but four ships in each fleet, my remarks apply to any number of ships.

In the present instance, whatever the number of ships contained in each column, on observing an opponent in two columns, it is necessary to form four columns. The columns are formed, if possible, at half the distance apart that the enemy's columns have. As in the preceding manœuvre, the signal is made "Pairs," and the pairs steered so as to allow the opposing ships to pass midway between them. The pairs on arriving within turning distance of the last ships, turn and ram as before.

In Fig. VII, we suppose the opposing fleet to have formed line-abreast at close order, two cables apart. This may be taken as an instance of Captain Colomb's extended front.

The attacking fleet now form at half distance, in line-abreast, and attacks one or other wing of the enemy's line. The duties of pairs are precisely the same as in the former illustrations.

In Fig. VIII, I have supposed the enemy to have closed to half distance, assuming that it would not be safe to close the ships of the attacking fleet any more, though I by no means admit that this would be the case with a properly instructed fleet. Assuming, however, that it would be impossible to close the ships, the combat would now resolve itself into a trial of nerve and skill between the commanders of opposing ships. Each commander would have to steer straight for his opponent; the first to swerve from this course would infallibly be sunk. This is the trial of nerve I allude to.

If, however, both hold their course, it is possible that both may go down, or that they may cannon against each other, tearing away all outer fittings, and pass on.

Should neither be incapacitated from continuing the action, the victory, or rather the advantage, would lie with the fleet that first turned round to renew the contest; for supposing one fleet to turn before the other, the first fleet would have their bows opposed to their opponents' stern, and these opponents would find it impossible to turn, as to do so, they would have to expose their broadsides.

Fig. IX. In the previous figure it was seen that the advantage lay with the fleet first round.

Fig. IX illustrates a means of securing this advantage to an attacking fleet. The fleet is divided into two ranks, each rank closing its ships as much as is compatible with safety, the ranks to be three and a-half cables distant from each other. This distance is assumed to be the diameter of the circle a ship makes in turning; it would vary with different fleets, and the distance assumed here is to be understood to be merely for the purpose of illustration.

The two ranks, keeping directly astern of each other, steer as in the foregoing figure, the ships of the front rank would jostle their

2 M 2

opponents as before, and immediately putting their helms hard over, turn towards the disengaged portion of the enemy's fleet.

The rear ranks would follow precisely the same course as the front rank until clear of the enemy's line.

Let us now consider the position of the enemy. But half this fleet could possibly be effective; this portion would be unable to turn immediately after the encounter with the front rank, as another similar encounter is imminent; the non-effective portion would be unable to turn toward their comrades, and to be of service must turn away from them. The period at which this fact would be realised by their commander is, however, uncertain, and I have given three illustrations, the positions 1, 2, 3, representing different stages, dependent on the time at which this fact is realised.

Position 1 supposes the movement to have been begun at the moment of the collision of the front rank and the right wing, position 2 supposes it to have been begun some time previously, position 3 previous to this again. Now in position 1 they are in comparative safety, but inoffensive; in position 2 they are in danger of ramming from their opponents' front rank; in position 3 they are liable to be attacked by pairs formed of uneven ships. In the figure, of A's fleet, No. 1 of the rear rank, together with No. 2 of the front rank, would be conveniently situated to form "pairs" of attack.

Whatever the position these ships may be in, it is the duty of the front rank to keep on the side most remote from the ships in the rear rank, ready to take advantage of any opportunity that may present itself of shutting the enemy in between superior forces.

I will now consider the objections to this manœuvre, and to my mind they are certainly grave ones.

Firstly, in separating a fleet into two divisions, on opposite sides of a hostile force, you violate the first and most important principle of tactics.

Secondly, during this time of separation, all communication is interrupted between the divided portions of the fleet, and they are mutually ignorant of each other's condition.

It is true that the period of separation is short, lasting only about four minutes, but a fault is not the less inexcusable, that it lasts but for a few minutes.

For these reasons then, I am not prepared to recommend the adoption of this mode of attack, on *all* occasions, but would leave this, and its predecessor as alternative modes of attacks, the selection of either being dependent on the character and ability of the enemy to be encountered.

In Fig. X, I have illustrated an attack, by a fleet of pairs, against a fleet formed in groups, and arranged in columns of groups in two divisions in line-ahead, I here extract from Commander Noel's book, the tactics adopted by a fleet of groups in this formation.

" If the enemy advances with a narrow front, the first division will
" attack by passing along the enemy's line, keeping outside it if possible,
" and the second division will charge the enemy, turning towards the
" enemy, as the leading opponents meet, so as to come in contact astern

"of the first division, just as the last ship of the enemy is clear, and "before they can have recovered from the first attack."

Now, against a fleet formed in pairs, this brilliant charge, with its consequences, could never occur; long before the second division could arrive on the scene, their comrades of the first division, would have been rammed.

Of this charge and its results it may be said, as once was said of another disastrous charge, "*c'est magnifique, mais ce n'est pas la guerre.*"

I have now concluded the illustrations of my system of tactics, my time has enabled me to show a few only of the modes of attack, but I may mention that I have myself drawn out twenty-five different modes of attack, and the system is capable of extension to twice, or even three times that number.

Throughout every attack, the same principle is carried out, namely, to bring two ships against one of the enemy. Against an enemy formed in any number of columns, this is done by forming double the number of columns at half distance.

Wherever possible, the closest order is kept, as it is evident that the fleet in the closest order, brings a superior force against a part of the enemy's line.

The various column formations, of which I have shown illustrations, are instances of the former of the two systems found in our signal-book.

Their great weakness lies in the want of mutual support incidental to the organization, and in the great want of mobility due to the same cause, the latter evil preventing any really tactical manœuvres on the field of battle, and confining the action of the fleet to its original formation for attack.

For these two evils there can be no remedy short of the abolition of the system; patchwork can produce no real result and will only complicate the evils it is intended to mitigate.

Guns and torpedoes have not been mentioned, the time at my disposal confining me exclusively to the question of rams. I have also ignored the existence of reserve squadrons. My reasons for this course have been stated in a former essay, but as the system has some supporters I will reproduce them here to give an opportunity for their discussion.

"*The employment of Reserve Squadrons in Action.*

"There appears to be a very general impression amongst Officers "that it would be advisable in any future battle to keep a small "squadron in reserve, to be used where the occasion presented itself. "The reason for this course, as far as I can learn, is that there is a "belief that however small the number of ships engaged, both sides "will be pretty evenly damaged and severely mauled after an hour or "so fighting, and that when both sides are exhausted, the arrival of "the reserve squadron will decide the fortune of the day; another "reason appears to be, that in case of defeat the reserve squadron "would be useful in covering the retreat of the beaten squadron.

"Now I cannot but think that persons who advocate such a system

"of tactics have grievously misunderstood the manœuvres of ou
"future battles. Lord Elcho, at a recent lecture at the Unite
"Service Institution, happily stated his position in opposition to son
"retrograde military reformers, saying: 'he was all against bow
"and arrows.' Now I think the advocates of reserve squadrons ai
"all in favour of bows and arrows. They appear to imagine that w
"are still in the days of Howe and Jervis and to have forgotten th
"revolution that has occurred in naval matters since those days.

"At the time of the old war when vessels hammered away at or
"another until one or other was exhausted, the employment of reserv
"squadrons might, perhaps, have been of some use; it is possible tha
"when after some hours' hard pounding, the combatants found them
"selves reduced to the position of the Kilkenny cats and driftin
"about as mastless hulks, the arrival of a fresh reserve squadro
"capable of sailing round and raking the cripples, might have turne
"the day; but even then, it was doubtful policy to keep a reserv
"squadron out of action, especially in light winds. At Trafalgar th
"rear squadron was routed before the van could succour them. Sinc
"those days a change has come over the spirit of our dream; it is n
"longer the good old fashioned pounding in which the combatant
"stood up to one another like two prizefighters—enduring thei
"punishment with an obstinate dogged courage—it is now a comba
"between skilled swordsmen, in which one thrust deftly delivere
"well home will decide the fortune of the day.

"Events succeed one another so rapidly on the field of battle, an
"the weapons of modern war—the ram and torpedo—are so speed
"and decisive in their effects, that each field of battle might almost b
"considered a theatre of war in itself. A reserve squadron unde
"such circumstances could not possibly hope to be of any assistanc
"to their friends.

"Supposing a reserve squadron to observe that their friends wer
"exposed to rams, could they arrive in time to save and protect them
"If they are to be a reserve at all they must be stationed so far o
"from the combatants as to be out of the action, and would probabl
"have some difficulty in distinguishing the exact place of the conflic
"from the amount of smoke that would hang about the combatants
"It would be easy to show, also, that were an Admiral so minded h
"could easily prevent his opponent from keeping a squadron i
"reserve, and that by the no more abstruse method than merel
"detaching a certain number of his ships to engage them. That
"however, is a course that would be adopted by few in employing
"*reserve* squadron; a Commander gives his opponent an opportunit
"of doing that which has been the aim of every skilled warrior fron
"the days of Alexander downward: he gives his opponent an op
"portunity of destroying him in detail, of routing and destroying
"first one portion and then the other portion of his fleet, and in thu
"exposing himself, he violates every principle of strategy and tactics
"What gave Nelson success at Trafalgar? He destroyed the rea
"portion of the French line before the front portion could turn round
"and succour them.

" The great principles of war are the same both afloat and on shore ; " and the advocates of reserve squadrons violate the first and principle " rule: namely, to endeavour to concentrate a superior force on a " portion of your enemy's force, and so to rout and destroy your " enemy in detail."

To the above remarks I still adhere, and nothing has occurred to induce me to alter or modify them in the least.

The subject of tactics, however, is as yet in its infancy, and indeed there are but few who can be said to have approached the question at all.

We have hitherto considered fleets equally composed, equal in every respect, encountering in still water, but we have to consider how to take advantage of superior numbers and force, and how best to compensate for inferiority of force.

It is also apparent that vessels steaming against wind and sea, will not attain the same speed or handiness as vessels going before the wind, we have to consider how, if we were in the first case we would endeavour to neutralise the disadvantage, or in the latter case how best to avail ourselves of the advantage. Hitherto also we have spoken only of the first charge of fleets, we have not considered how we may best re-form, to take advantage of the results gained in the first onslaught. My time forbids my touching on these branches of the subject. I must be content to indicate them as works of study, and demanding attention.

It must be remembered that seamanship and tactical skill are born of forethought, and if we are to acquit ourselves in the manner our past history and traditions demand, it is only by earnest and careful study that we can aspire to do so.

I do not think more can be said to commend the subject to all Naval Officers.

The CHAIRMAN: After this able paper which has gone into so much detail with regard to the manœuvring of ships, we hope that some gentlemen present will be ready to offer some observations.

Admiral Sir HENRY CODRINGTON, K.C.B.: I should like to make one or two observations. There is a great deal in what the lecturer has said as to attacking in pairs, though I disagree with him entirely as to the making the ship apparently nearest to the Admiral, the Commander; because even in some of the diagrams that he shows us, the distance between the Admiral and what I may call the starboard ship of the two, is but a trifle more than the further one, and in the close order in which they would be for this purpose (which he very judiciously advocates) I think there would be scarcely any difference, considering the quantity of smoke there would be, and the other impediments, wind and waves, and so on, and I do not see any reason for the temporary unshipping of the senior officer from the direction of the two. Moreover, I think the Admiral should retain the command as much as he possibly can at all times over all his pairs, although the signal may have been made according to the proposal for pairing.

Coming now to the diagrams. I think it is fair to assume that the enemy whom we attack, will at least be as judicious as ourselves in keeping to as close order as we do. We must not suppose that an enemy's squadron is to be conveniently in open order, whilst we go in close order at it. It is fair, therefore, to give him credit for just as much, in short, as we have ourselves; and, moreover, it is also fair to suppose that he is equally determined to ram; in short, equally determined

to use all his advantages of wind, weather, seamanship and material, as we ourselves are. Now, in this diagram (Fig. 1) it is said that these two ships marked B are to turn and ram that stern one. But what in the meanwhile is to take place? Those two ships marked A have passed the senior officer, and have each of them received as good a broadside from him as they would deliver to him. They do not pass on quite unscathed. They are enveloped in a cloud of smoke, unless the wind conveniently blows it away from them all; and it is fair to suppose, therefore, that they do not immediately see what the ships astern of the opposing Admiral are doing. Suppose, therefore, that the ships of the opposing Admiral have had equally good communication with their Admiral beforehand, to know what his general views are on the subject of ramming, and that they are equally determined to ram these two as fast as they possibly can, and not allow them to get through to the sternmost. Supposing as this ship gets in the middle of the smoke she suddenly finds this one coming right at her starboard bow before she is aware of it. I think it is fair to suppose that these two are not likely to get on to the third one astern; they would probably be exceedingly well mauled before they did that, and we must conclude that the accidents of warfare in this sort of way, the concussions and all that took place there, would make a very large deduction necessary from the certainties of the success of a system of this sort. We have no right, therefore, to calculate that those two ships will get through so unscathed and pass the three as to maul the rear one. But supposing that they did get through rather lamed, but complete their original intention of trying to ram him. We may suppose he is not likely to submit to it patiently, but at any rate he may say, "I will take my chance against one of them;" and he goes right at that one; and supposing that takes him on the outside bow, he would cannon off from him before the other could get at him, because he going in this way would reach it before the other one would reach him. We must always remember they are moving at a great rate, and that the opponents do not know each other's intentions, and the man of quickest action in the hour of need, is the man who would win the battle in those cases.

The lecturer also spoke about cannoning. There was an instance of cannoning which I happen to know of, from the explanation given to me by one of the parties to the conflict. It was a case of a German and French ship in the West Indies, and I happen to have had the pleasure of the company of the commander of the German ship at Devonport. He gave me a description of the fight, and it really was very instructive. They were not ill matched as to armament and size, the French ship being rather bigger and higher. They commenced the action, as they thought, out of the Spanish waters, though very close to the edge. They began firing and keeping at a certain distance, going round and round. The French ship found that the German was doing better with his long gun, there was more damage done to the Frenchmen, and he thought it better to ram. In the cloud of smoke which rather blinded the German, the French ship was suddenly seen coming down right at her; the German had just time to port his helm to starboard, and to meet her as directly as he possibly could. The French ship was the higher ship, with an upright stem, and he just avoided meeting stem to stem, but they ground alongside of each other. The German had prepared by laying his guns ready for firing, and desired his men not to fire till he gave the word. As the French ship came alongside in that way, her bow struck the first gun and capsized it; she struck the second gun and turned it aft, so that it could not be fired, leaving the third gun,—I forget whether he said that was fired or not; but the port channels of the German were cut away, the result being that down came the masts and the gear fouled the German's screw. The Frenchman ranged ahead, passing away astern of the German. Both were, comparatively speaking, temporarily disabled; the victory evidently was to the one who would regain the command first. Something happened to the Frenchman, and he was unable first to turn round. The German worked very quickly and cleared his screw, luckily for him, and cut away his wreck. He was then without masts, in the shape of a gunboat, but with steam power efficient to turn round and get his long gun to bear. He hit the French ship two or three times; after one shot there was a burst of steam, and the Frenchman was disabled by a shot through his steam chest or his boiler. The victory then would certainly have been to the German, because he had the moving power and could have taken up any position

he chose. It did so happen that then the Spaniards came out and put an end to the conflict. I mention this instance to show what may be the result of a cannoning. We cannot say who will be disabled, or who will not, but we may be certain that both will have had a very severe shock, which may try them very much before they can turn round and do anything. Now imagine any form of this, and think what shock would take place there, because we must remember our enemies will not stand quietly to let us pass them and attack the sternmost ship, but they will very likely go at us just as much as we would at them, and therefore I think it is that with a second line, whether it is in force astern or in any other way, the victory will be to the second line that comes in and goes at the temporarily disabled ships. If a ship has rammed another and there is time for a consort to come up before she can back astern out of that (and remember how long it is before a ship can get away when she has to back astern from ramming a ship), I think the victory would not always be entirely to the first rammer. It is almost impossible to predict what would be the result of a conflict in that way, unless there is a reserve squadron. And the reserve squadron must not be out of sight at the present day; the reserve squadron must be a second line, but a second line so close as to take advantage of the ramming of the first line. Nobody would detach a squadron out of range, if that squadron is intended to act in the battle at all. It was very well in bygone days, but even if our forefathers could be alive now, their reserve squadron would be within 500 yards, not further than that. I scarcely think the illustration given of the flank movement (Fig. 3) offers a fair argument. We are supposing there that we have caught an enemy in the act of changing front, caught him *in flagrante delicto*. I do not think we have have a right to do that. I think we must suppose that he has been equally on the look out as we have, and if he has been caught so, or if we were caught so, we must conclude we are at a disadvantage. I do not know anything better than for that squadron to turn and ram as fast as they can, but I do not think it would be right to take that as an argument that that squadron is, in the face of this formation, coming at them to try to form a line in that way.

It is difficult to follow perhaps all the rest of the diagrams, but I think I have touched the most material points that have been mentioned. I should sum it all in this, that we really must consider that our enemies, whoever they may be, will be quite as awake as we are to the value of very close order, and ramming as hard as they can. I believe, whether we are unfortunate enough to have to go to war with one nation or another, we should find them equally alive to that, and we must be prepared for that too; and my own impression is that we should have a second line ready to take advantage of the result of the attack of the first.

Commander Usborne, R.N.: I feel rather a difficulty in addressing this meeting after the very able speech we have listened to, but I think our lecturer has certainly committed the very grievous fault of despising his enemy; I think the enemy who would allow themselves to be caught napping in the way the ships marked A have done, certainly display ignorance of naval tactics. If the rear ship (Fig. 1) had closed up astern, the headmost one ahead of the two wing ships, when the attacking ships passed the blue leader (A) both their flanks must necessarily be momentarily exposed to the bow of the ship which is the second astern, and she might take her choice of either one or the other. If she turned to starboard and rammed the left ship of the pair, then, if the right ship turned to follow her, her flank would be exposed to the left wing ship, and *vice versâ*. That I think was fully pointed out by Sir Henry Codrington. In the right diagram (Fig. 10) I think the ships marked B have placed themselves in a very bad position indeed, and if the ships marked A allowed the enemy to pass between them unscathed, they would deserve all they got. There is certainly nothing in that diagram to prevent the left ships A stopping their engines half a minute. The right ships would be passing a-head of them, and as the ships (B) passed their proper right, they would certainly expose their beam; there is then nothing to prevent the ships A on the left turning to starboard and ramming. And I see no reason to despise a reserve. In all these formations if the ships A had had a reserve, if those B had got at all touched, the reserve would certainly have had them in their own power. And I think we ought not to despise the tactics that were practised by our old admirals; on the contrary, we have a great many lessons to learn from them. The "Nile" undoubtedly was won

by placing two of our own ships to each of the enemy's; it was that that gave that great battle, and that must be our great object. Naval tactics must always more or less like a game at chess: you advance in order, but after a very sho time, a great deal must be left to the individual captains; and Nelson invarial said he trusted his captains, and that in such cases the captains of ships must depended upon. Therefore, individual ships and not a group should be the tacti unit. In the case of pairs, what with some of our ships being rams and others n some turrets and others not, some fast steamers and some slow, some with hea guns and others with comparatively light guns, it is very difficult indeed to p ships off so that one could always assist the other. I consider that after the fi brunt of the battle, the individual captains must have a great deal of the respon bility upon themselves, but, of course, always subordinate to the Admiral.

Sir Henry Codrington: I forgot to mention one point about the coun of war. I think the lecturer is mistaken as to that. Councils of war are thin of such very old date now, that they would be more sedentary councils, r councils in the presence of the enemy. Admiral Lord Nelson took opportunities sea for collecting his captains, and in conversation showing them what were l ideas of tactics in particular exigencies that might arise at any future time, ar therefore, they were all conversant with the way in which he would act, a therefore, they acted according to his instructions without any signals whatev That is a very useful thing. But as to anybody having a council of war in t presence of the enemy, it is utterly out of the question, one never dreamt of it certain

Captain Needham, R.M.A.: I feel somewhat out of place in addressing meeting at which there are present so many distinguished naval officers; but havi listened with great interest to the very lucid lecture we have just heard, I shou like to ask the gallant lecturer one question. The essence of his system seems be, that success is to be gained in battles at sea, by two ships acting together concert, and I wish to ask him whether he really believes that is possible for ev so small a number of ships as two thus to act in concert after the battle has on become general? Because I think the history of past battles goes far to justify t presumption that when fleets have once become actually engaged, concerted acti between ships is an utter impossibility. If we go back to distant times, to the days the Romans, we find them fighting with galleys propelled by rowers and armed wi spurs and beaks, therefore, on a small scale somewhat similar to the modern stea ram, but we do not find mention of any manœuvring having been attempted wi these galleys. When ships fought under sail and with guns for their main weapo no tactical manœuvres seem to have been carried out, in fact, the characteris feature of those battles seems that each ship went at the nearest hostile ship a clung tenaciously to it. In the three actions which have been fought between irc clad squadrons, we find that immediately after the action commenced, the battle all three cases degenerated into a melée. In Admiral Teghetoff's account of t battle of Lissa, he states that immediately after the battle began, the melée becar general, and every minute the contest became more confused. He describes t ships as crossing and re-crossing one another so rapidly, that it was alm impossible to distinguish friends from foes; and further on he ascribes the victo partly to the fact that the majority of the Sardinian ironclads were painted gr It appears to me, therefore, that amid the confusion necessarily attendant upon action at sea, the commander of every ship would require to devote the m extreme care to prevent his ship being rammed, and to seize any opportunity th might occur for ramming or otherwise injuring an opponent; and, therefore, if l attention is diverted from this task, in order to watch the movements and act concert with another ship, his own ship would very probably come to grief; and th therefore, although concerted, tactical manœuvres may be of service in order bring ships advantageously into action, yet that when once the battle has fai begun, we must trust for success to the possession by our captains of those qualit which have always distinguished English sailors, namely, quickness of decisi promptness of action, and a superior power of giving and taking hard blows.

Captain Brent, R.N.: I am afraid I must disagree with the lecturer very muc in fact, I disagree with his premises entirely. It seems to me that he wishes tl the principles of the signal-book should be that of fighting tactics. Now, t

signal-book, I believe, should be entirely for evolutions; have in it as many evolutions as you can, lay down in it all the formations you think necessary, but the tactics of the battle must rest with the genius of the Admiral. If you make the signal book the fighting basis, you tie your Admiral down, so that he can do but little or nothing, you give him no opportunity of exercising his skill and judgment. If an Admiral chooses to fight in pairs, by all means let him; if he chooses to fight in a square, let him do so; if he chooses to fight in pelotons, by all means let him do so; give him every means of signalling and manœuvring, but the signal-book should not give a fixed and definite form of fighting a battle. It is an evolutionary book with all forms of evolutions for the Admiral to make use of, but the fighting must be left to him alone, as he is responsible for the result. As to this system of pairs, it is to me merely the group system, less one ship and without the power of the senior Officer; the junior may have command at one time, or the senior may have command; you lose the directing power of your senior. In a disciplined service you do not quite look with that respect to the junior that you do to the senior. You lose that, and you have two ships instead of three. It is worse than the group, for the inside broadsides can never be used, but with the group they can use them both. I am not arguing for the group, I do not believe exactly in the group; it may be wanted, I leave that to the Admiral. I do not think we have any knowledge as yet, to enable us to say what will be our fighting formation. We know nothing about it literally, and as far as our signal books are concerned, we can only put in them everything we can think of, to give the Admiral all the power we can. The lecturer said, speaking of No. 1 diagram, as the two ships (B) passed the first ship, they would both fire into her; I should think that would be very dangerous, the chances are you would fire into your friend. As to the rest, I need not say anything after what has been said. With reference to Fig. 2, if I remember right, what Captain Noel said in his book was, that the leader makes a signal for the outside ship to form under cover—he would not leave him out there with two ships away in front—he forms under cover, but you cannot say what they would do exactly. I beg quite to endorse Sir Henry Codrington's remark, that you must allow your opponents to have the same ability, and perhaps better than you have. The formation here (Fig. 5) seems to me to be another very dangerous case, the two second ships are to be left away astern, the two first ships are to go through and then to turn round. You could not suppose the ships marked A would turn round also, seeing an enemy in front and ready to come down upon them, and you would have your own ships advancing towards one another with the enemy between them, and might as likely be rammed by one another as well as by the enemy. I have nothing to say against fighting with two ships, it may be practicable for all I know, our signal books give the Admiral power to do so. As to the council of war, an Admiral who sent for his Captains to discuss with them what he should do, is simply, I should think, incapable. I can understand his sending for his Captains, and saying, "I am going to do so and so, and "you will do so and so," but he does not send for them to ask them what he should do or to take council with them. He would send for his Captains and tell them what they were to do and what he was going to do, and it would be of the greatest importance to know what your Admiral was going to do, for you would then know what to expect under given circumstances and how to act.

Mr. Laughton, M.A., R.N.: You put me, Sir, to a severe trial, in calling on me to address the meeting on such a subject as this, especially after we have heard Sir Henry Codrington and Captain Brent, who speak with authority, as having actually commanded fleets and ships, whilst I know but little about it, except from having read and studied in my own room. I am inclined to differ very much from the lecturer's views, both as to the efficacy of the pair and as to the inefficacy of the group. He speaks of the pair as having unity of action, and as depending for success on that unity; but surely, if, as has been recommended by the advocates of the group system, three ships are carefully and deliberately selected and trained to act together as one, those three, so trained, will be more efficient and more powerful on any given spot than two told off to act together only for the time being. In the proposed attack of the pair against the group, it cannot be supposed that the rear ship of the group would be in the position shown (Fig. 1). Captain Noel has

provided against such a case, and as Captain Brent has just said, she would be under cover of No. 2; the only result of such an attack would be that the port ship (B) as she advanced, would receive three very close broadsides, returning one, or possibly a second, with a hurried and irregular fire; I take it that these three broadsides rattling in, one after the other, would be more than unpleasant. The few shot that escaped her would most likely take her consort, who would be otherwise out of the action. It would, in fact, be a case of one ship getting in amongst three trained to act together, and the one would certainly come to grief. In the case where the ships marked A pass down the ships marked B formed in line a-head (Fig. 6) (supposing an enemy is found so imbecile as to adopt such a formation), the leading ships would, as they pass, receive the broadsides of every ship in the line, so that if it was a long line, by the time they had passed three or four, they would have each had three or four broadsides, and those two ships would be much more inclined to look out for their own safety than to carry out any plan of concentrated attack. Then again, in the very close order of line abreast (Fig. 8), to bring a number of ships against an equal number in the way shown, and to try which has the hardest nose, might be very gallant, and would certainly require a great deal of nerve, but it would not be tactics. There is no tactical skill in meeting an equal force with an equal force; it has been proved over and over again in all history, that meeting ship by ship cannot lead to any decisive result, unless there is great individual difference; that if the forces are really equal, nothing but manœuvring in some way, so as to bring two or three or more ships to bear on one, or a large part on a small part, can possibly be successful. Let the enemy take what form he will, I conceive there is no tactical advantage in attacking him in any way that will not bring the bulk of the attacking force to bear on a small part of the attacked. I think that the formation in groups is the most likely to lead to such a result; I believe that in groups, the fleet can take closer order, when necessary, than in any other mode of formation; and for this reason, that the ships do not, in any way, cover each other; and they can close up from the formation which Captain Noel has prescribed into an order very much closer, still retaining the same bearings; provided that the stem of No. 2 is clear of the one quarter of No. 1, and the stem of No. 3 is well clear of her other quarter, so that any sudden stoppage of No. 1 will not cause a foul; they may be as close as they can possibly pack, without any danger of a collision; twenty or thirty yards clearance, on each side, would, I take it, be enough. Three or four such groups arranged in echelon or triangle, would form a column, which I conceive would be irresistible, if by previous manœuvring it got anywhere near the flank of any enemy in line-abreast; for it would be in very much closer order than any line-abreast can possibly be in. Under such circumstances, I think a reserve would be effective, if the fleet was large enough to allow it. If, for instance, the fleet consists of five or six such pelotons, three or four might form the charging column, whilst the other two or three would form an independent column, manœuvring so as to deter the rest of the enemy's fleet from wheeling round to the support of the attacked wing. I believe it could do that without engaging, but merely by manœuvring, so as to turn its flank if the line wheeled.

Sir Henry Codrington has so well met the idea of the conference, or council of war, that I do not think I need say anything further about it.

The CHAIRMAN: I do not think the lecturer himself insists on that; he is rather opposed to it.

Mr. LAUGHTON: Admiral Jurien de la Gravière, who has been often quoted by our tactical writers, has maintained that one great cause of Lord Nelson's success, was the amiable way in which he held intercourse with his Captains, so that they knew exactly what to do; and I think this is one very strong point in favour of the group system. The commanders of the groups would be Admirals or senior Captains, men probably on intimate and friendly terms with the Admiral, and who in harbour or on previous occasions, would have often discussed these matters over their port wine and walnuts, and be thoroughly acquainted with the Admiral's intentions. If he had to talk it over with 18 or 20 Captains, some of them men of another generation, there would not perhaps be the same friendliness and the same *entente cordiale*.

Lieutenant BOWER, in reply, said: Several allusions were made to this Fig. 1, and the remarks I shall offer in reply will be understood to refer to all those allusions. The first objection raised was, it would be dangerous for the ships marked B to deliver their inside broadsides while passing the leading ship of the enemy. I do not think firing an electrical broadside in this position would be attended with any particular danger to either of the opposite ships, because the distance is so very close that for a shot to miscarry must require a great amount of bungling on the part of, we will presume, the intelligent gunnery Lieutenant who fires the broadside. I was asked if the wing ship turned towards the pair what would happen? In the first place it would be a sufficient answer to that and to all these questions about group formation, to say that no provision whatever is made in our signal-book for all these manœuvres that have been recommended by the various speakers. There is not the slightest mention, nor has any Admiral or group-leader any means of ordering his consorts, or vessels under him, to perform any one of the evolutions recommended by the various speakers. There is no signal that would order those vessels to turn inward. It would require at least a dozen flags to do so. But even were those signals made, and were they willing, it would be a physical impossibility after these two vessels had passed the leader for the two wing ships to do them any damage. A vessel makes, roughly, a circle somewhat over 600 yards in diameter; it is about 700 yards with most vessels; these vessels are moving with the combined speed of twenty knots,—the two fleets,—and if after passing the leading ship, the wing ship of the group were to endeavour to turn and ram the ship marked B, she could not possibly do it. The distance from ship to ship is two cables. I am not prepared to work out a right angled triangle at this moment, but about two cables would be the distance she would have to perform as the diameter of a circle to do so; that would be about 400 yards. It would be quite impossible for this vessel to turn in 200 yards as the half diameter of a circle, at any rate with any of the ordinary iron-clads.

I now come to Fig. 2. In this case Captain Brent recommended that the rear-ship should keep under cover, and suggested that Captain Noel points out that the rear-ship could go under cover in such a case; so she could, but she would be quite useless there. Of what use would a third vessel be in such a case? It would require a considerable amount of ingenuity for a vessel of the pairs to place herself across the rear-ship's bow, or in any position capable of being rammed; and it would require a certain amount of ingenuity for the right-hand vessel to place herself so as to be rammed.

Fig. 3 is the flank movement, and I think every evolution in our signal-book ought to be designed for the field of battle. Captain Brent recommends that a large number of evolutions should be included in our signal-book for peace purposes, and that an Admiral should be allowed his option of selecting from them and framing his system of tactics from it. In my system of tactics I have but twelve evolutions; with these 150 formations can be performed, and my argument is that by having but twelve evolutions, and by compelling your Admirals of fleets to use them and no more, you will, when you go on the field of battle have such a proficiency in their execution, and be so thoroughly accustomed to carry them out in every detail, that you are likely to be better up in them than you would if you had a large number, some of them probably practised for the first time on the field of battle. Here we have the flank movement; I show here one of its dangers on the field of battle, and that alone should be sufficient to condemn it. If another evolution will work on the field of battle, then surely that one ought to be preferred to one which will under certain circumstances work, and under others will not, for by practising the one that will work in the field of battle, we surely obtain a better proficiency in it than by practising with two.

In Fig. 6, we come to the case in which Mr. Laughton, I think, pointed out that the vessels would get a certain amount of fire as they pass by. I am speaking of ironclad fleets, and I do not think any vessel will be damaged so far as to prevent her continuing the action, or be damaged in any way as far as her speed and handiness are concerned by the first broadside or two of an enemy. So long as we can keep out shell, or shell with large charges, I do not think we have very much to fear from shot or shell with small charges; and even if a shell does penetrate

the battery and kill a large number of men, I do not know that that in any degree affects the system of tactics; so long as the helm and engines are both able to work, I am quite ready to carry on the fight.

Some of the speakers recommended a reserve squadron, and some speakers pointed out the danger the rear rank in the attack in line-abreast being left to themselves in the rear, while the other two went forward to the attack. Now, these vessels are perhaps a reserve, and it is the only case throughout in which a reserve is employed. When I said I objected to a reserve squadron, I meant a squadron employed as a reserve. I do not call this a reserve at all; anything within 300 yards of the enemy cannot be called a reserve. The danger was pointed out of dividing your fleet in this way, and at the same time the same speakers recommended the employment of reserve squadrons. Surely this is an inconsistency. If it is dangerous to divide your fleet, surely it is dangerous to employ a reserve squadron under any circumstances whatever.

Now about the cannoning. Mr. Laughton pointed out that there is no advantage to be gained here. No more there is; there is no tactical advantage, and I do not see how tactical advantage could be gained in any way. I only point out the only means, not of gaining a tactical advantage, but of saving yourself. Were any other means adopted, certain disaster must ensue, because a large force will be brought to bear against a portion of the enemy's line.

Mr. Laughton made a few remarks also on groups, which I should like to notice. He says he has studied groups in his own room. I can see no reason why he should not study groups as well in his own room as elsewhere. Every formation that an enemy is capable of assuming is limited. There are only certain mathematical figures that he can use; modifications of the triangle, straight lines, or a circle; and, as he can consider every one of these forms, so he can consider the forms to be used to defeat them; and, in my system of tactics, I endeavour to point out precisely what is expected of every ship, and what the object they are to aim at. Should circumstances arise that prevent them carrying out their object well, a unit composed of two ships is not so large as to be unwieldy or to prevent communication between one and the other.

Admiral Codrington objected to my taking away the command from the senior Officer. I suppose in this case (Fig. 5) the leader of right column is to be the Admiral, No. 2 in port-column is to be the second senior Officer. During the whole time of passing along the line, these vessels are shut out from the view of the Admiral, and cannot see the Admiral, but the ships of pairs can communicate, should there be anything to require any alteration in their conduct.

Mr. Laughton pointed out the advantage to be gained by groups in close formation in attacking the wing of an enemy. But he has first to get to the wing of an enemy, and a group is so difficult to maintain in action; it requires the use of compasses, and it is so difficult even in the closest order to maintain, that I do not think it could last long. By my system there are no compasses required. You do not steer by your Admiral, but only by your enemy; every ship has a distinct duty to perform and steers only for her enemy. Mr. Laughton reminds me very much of a man who takes a spade to saw wood. He has pointed out how groups can be easily manœuvred in close order and in various ways; and he has then fallen in love with his group, and takes it to the field of battle, and expects it to do wonders. But on a field of battle his group will not fight, and that is the one object for which the British Fleet is designed; and, unless the evolutions are designed to meet the varying conditions of a field of battle they are useless for our purpose. I do not know that there is anything else that I have to notice. The remarks offered were so extensive, I am afraid I have not been able to take notice of all of them. Captain Needham recommends that we should trust to seamanship, but surely we best learn seamanship and confidence in a field of battle by knowing what we are going to do before we get there.

The Chairman: As there is another paper, or rather an explanation to be given of the model before us by Major Innes, I will ask the meeting to return their thanks to Lieutenant Bower for his interesting and able paper. He has brought before us a subject of the greatest interest to naval Officers, but I think, from what we have heard to-night, we may conclude that a great many actions will have to be fought

before we can arrive at any very definite conclusions with regard to the tactics of the future. The whole subject is one of great novelty and full of difficulty, including the questions of ramming, of torpedoes, of guns, and speeds of ships, and of the circles in which they can turn, and so on. The question chiefly before us to-night has been whether a group of three ships or a group of two ships is the best formation for fighting. It is quite evident if you can bring the three ships to bear upon one they will probably do her more damage than the two. One thing has been very satisfactory to me, to learn, on the authority of Lieutenant Bower, that our gunnery practice has arrived at that degree of accuracy that two ships can pass an enemy's ship, leaving her between them at the rate of twenty knots, for they are each going ten knots in different directions, and that every shot from the two ships will be sure to hit the enemy's ships between them and not miss her, and thus damage each other. Assuming on his authority such to be the case, it certainly shows what a great advance has been made during the last few years in the practice of naval gunnery. I beg to return to Lieutenant Bower our very cordial thanks for a most interesting paper.

NOTE.

FIG. 1.

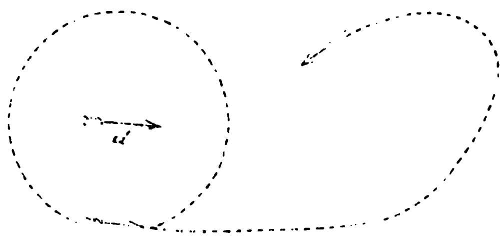


FIG. 2.

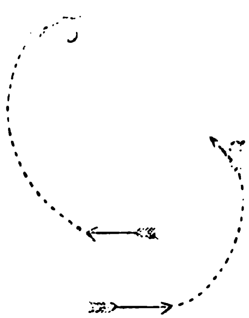
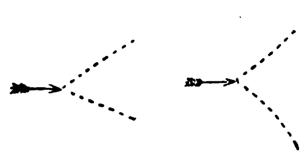


FIG. 3.



As it would seem from the discussion on my lecture, that some misapprehension exists as to the properties of the inner circle that enables me to disregard the movements of the wing ships, in my attack on groups, I would make the following explanation of them.

In Fig. 1 I have illustrated the first application of the principles. It is evident that there exists a position in which (*a*) may rest relatively to (*b*) in security, that (*b*), in order to ram (*a*), will have to steam off at a tangent to the circle, then turn and charge.

In Fig. 2 this principle is applied to two ships meeting; here (*a*) and (*b*) are m ing, (*a*) turns to port, (*b*) to starboard, the result being that (*a*) finds himself the inner circle as regards (*b*), and in safety, (*b*), being on the outer circle, i danger.

Fig. 3 is a further extension of the same, and applied to illustrate the sternm position, which is one always on the inner circle.

Now, in the attacks on groups shown in my lecture, the pairs are in safety, and the inner circle with reference to the wing ships, directly they pass the leading sl of groups.

The attacks in line-abreast are applications of Fig. 3, and endeavour to utilise sternmost position.

In considering all tactical diagrams, motion on the course must be counted double motion normal to the course.

As the safety of discharging the inside broadsides of the pair in Fig. 1 has b doubted, I would submit the following for consideration.

The guns of most of our modern ironclads are concentrated amidships; assum that the length of battery is equal to 100 feet, distance of ships apart = 50 yards, t length of ship = 300 feet, we have the limiting error admissible for forem and after guns = $\tan.^{-1}\frac{1}{3}$. Whether an electric broadside can be discharged wit these wide limits can only be determined by experience; but whether it can or it must be remembered, that if dangerous for the pair, it is equally dangerous the wing ships of the group.—G. B.

SELF-ACTING GUN-CARRIAGE WITH ELEVATING MANTELET.

By Major ALEXANDER INNES, Aberdeen Artillery Volunteers.

THIS model of a self-acting gun-carriage has been constructed to ill trate a new and original method of dealing with the requirements modern gunnery, involving the working of guns of unprecedent power, weight, and magnitude. But, before attempting to go into t technical details of the model, I propose lightly to sketch its orig and the objects in view for the construction of its several parts.

Let it be supposed that an emergency has arisen, that certain poir in a line of coast defence are threatened, and have to be armed on t shortest notice with heavy guns, where little or perhaps no effectu works of defence exist; that a gun is required that shall be capal of sustaining and returning opposing fire whether vertical or ho zontal, and whose carriage, mode of mounting, &c., shall possess their construction effectual shelter and adequate security for its a munition and detachment; that it shall possess an improved ramm which shall secure the most rapid and effectual means of loading a sponging, with a laying and sighting apparatus to enable the layi of the gun to proceed simultaneously with the loading.

The subject thus seems to divide itself into three problems, namel

the best method of receiving the impact of the opposing projectiles; the most compact and expeditious system of sponging and ramming home the ammunition, with provision for its safe supply and working for the gunners; and improved method of sighting, for bringing the gun into alignment and range, so as to be found in immediate collimation when run up to the firing position.

To meet the first requirement (in the absence of regular works), the only shield likely to divert a projectile from its mark, and to receive with impunity the effects of the blow, seems to be wrought-iron, of well-proportioned strength, weight, and thickness, but, above all, of convenient form and nature of suspension so as to absorb and reflect the force and effect of the impact of projectile.

To illustrate this, we may refer to the well-known feat of supposed strength for a man to sustain the heaviest blows from a sledge-hammer (which would otherwise prove his destruction) on an anvil placed and supported on his breast while lying horizontally between two stools or supports.

In providing for the second it is obvious that any defence of the nature of an elevating shield in front of the gun, necessarily so close as to cover the gun from the effect of vertical fire, when in the act of loading, must necessitate a very compact apparatus of certain and easy application. That this may be accomplished in various ways I do not doubt, but I have not yet met with a substitute for that employed in the model.

Lastly, the value of ammunition and projectiles for present and projected weights and calibres of guns is so great that any method securing accuracy of line and elevation for range must prove a valuable attribute for ordinary practice, but how much more in actual service, when rapidity of fire on moving objects becomes of the first importance.

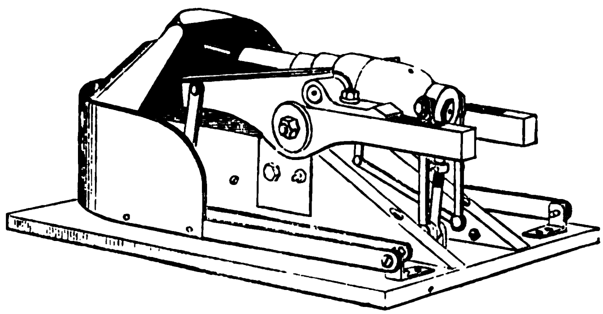
Turning now to the model, the first principles of which I sketched out a dozen years ago, and the soundness of which seem demonstrated by their closer application to the apparent wants and defects in the working of the new heavy guns of position, I would not have it supposed that I presume to discuss, much less to condemn, the existing system of batteries and fortifications, or to go into the rival questions of breech-loading and muzzle-loading. I only venture to assume that a gun of this nature may be placed and hold its own in a position unapproachable in present recognized systems of fortification which require time and capabilities of ground for their execution, and which find their places most accurately on the plans of the enemy when rapidity and secrecy in preparing for defence, present the first elements and prospects of success. This gun, however, requires nothing beyond a level surface to sustain its platform, as it provides for itself all necessary cover and protection.

The model as first presented to view (Fig. 1), mounted on its cone turntable,[1] is in the firing position. On being discharged, in consequence of the balance-cheeks being blocked up (they are removed in the sketches), the gun on its recoil produces no other effect on the

[1] The cone turntable is not shown in the accompanying sketches.

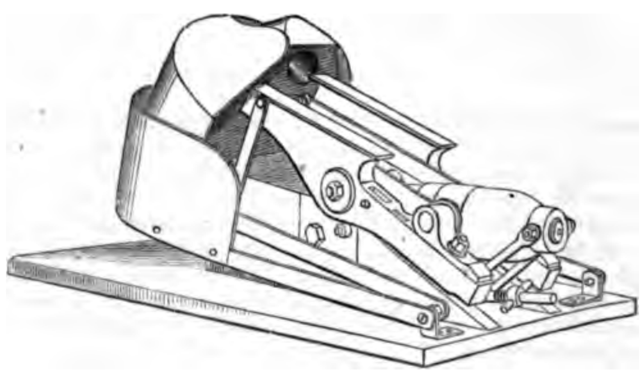
mantelet than is necessary to absorb the effect of the recoil, provision being made in this manner for working the gun should the elevating action of the mantelet be thrown out of gear.

FIG. 1.



In order to increase the cover, and to secure the operation of loading from the effect of vertical fire, it will be seen that on the blocks being removed when the gun has run back under the effect of the recoil, the mantelet will rise in any proportion that may be desired, and the gun subside into the loading position (Fig. 2).

FIG. 2.



Having now come to its bearings, the muzzle of the gun is found to drop into position to receive in succession the sponge and lubricator, upon which it takes a slight elevation on turning on the trunnions and receives the charge and projectile, dropping again to be rammed home and returned to the firing position.

The rammer is constructed of an interior and exterior tubular arch of metal, so divided as to coil round a toothed wheel, and is made to deliver the sponge, lubricator, and rammer heads in succession down the bore of the gun, and last, not least in importance, to keep down the

temperature of the gun by a copious supply of water delivered in the chamber of the gun.

In the model, the action of the mantelet and its distance from the muzzle have been *designedly exaggerated* in order to give the best opportunity to examine the apparatus for taking up the recoil; but it is evident that in a practical adaptation, this would be reduced to a minimum for the security of the ammunition, the gun, and the detachment.

The thanks of the meeting were then voted to Major Innes, for submitting the model of his carriage for the consideration of the members.

PLAN FOR PROTECTING SHIPS (AT ANCHOR), BLOCKADING A PORT FROM ATTACKS BY OUTRIGGER WHITEHEAD, OR HARVEY TORPEDOES.

By Lieutenant CHARLES LINDSAY, R.N.

THE mode of conducting naval warfare has undergone great changes in, so to speak, late years, through the introduction of torpedoes. This new weapon being unseen, and taking effect under water, is all the more difficult to guard against. Hidden enemies being always the most dreaded, the moral effect is very great; so much so that a fleet was kept off a port, in the late war, by a harbour protected by dummy torpedoes. When the torpedoes arrived, the burgomaster was afraid to charge them, but laid them out empty. And at the completion of the war, when the dummies were taken up, the burgomaster was congratulated by several consuls on the masterly way in which it had been performed, no loss of life having been caused in the task—really a most dangerous one, as we know that after the American war, at Charleston, where the same men who laid them down took up the mechanical torpedoes there was great loss of life.

Many attempts have been made to protect ships against this hidden foe, by increasing the number of compartments and by giving ships double bottoms.

But the subject I wish particularly to treat of, is guarding ships against offensive torpedoes, viz., the Whitehead, the Harvey, and the Outrigger.

In 1873, the "Monarch" was protected against the two latter descriptions, under the superintendence of the Naval Torpedo Committee, by her own spars and stores; but as the "Monarch" had been only temporarily commissioned for the visit of the Shah, and had not her stores on board, she was supplied by the dockyard with what were called her own stores. She used her topmasts, trysail masts, and longest spars; round these spars were hawsers, at various distances from the ship's side, of wire and rope, and from bow and quarter-spars were hung grapnels. This took about a week to get ready, but it was said that it could be done by a ship, with her own spars and stores, in twenty-four hours.

This protection will be seen at a glance was useless against the Whitehead, as we know that it can be set to go at a certain distance under water, therefore obstructions on the surface were of no avail.

The ship was partially protected against the Harvey by the grapne's,

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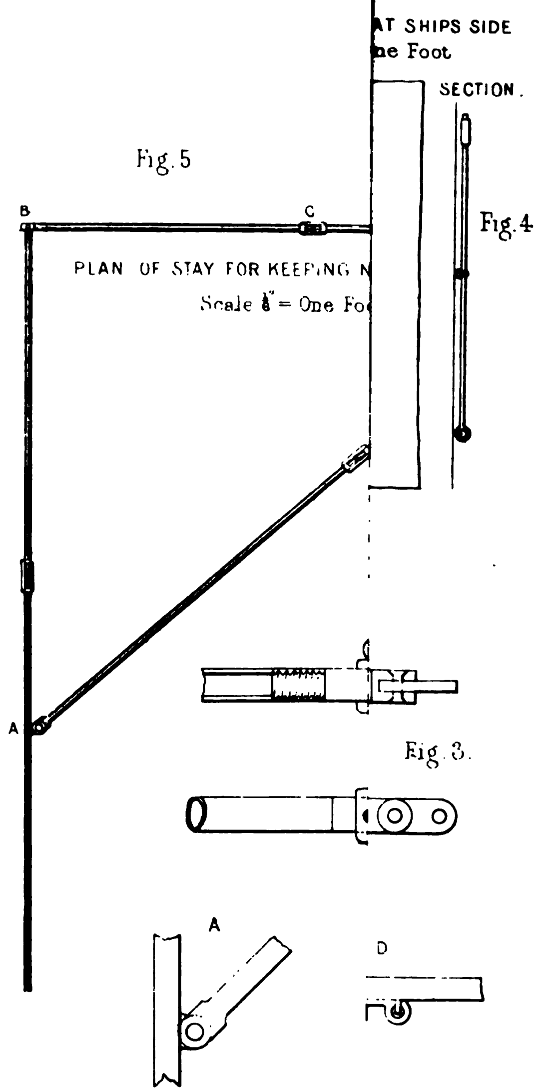
PLAN FOR PROTECTING SHIPS (TORPEDOES.

CHARLES LINDSAY,
LIEUT R. N.



J Jobbins

for a gun-boat tried to strike the ship in passing, but once only the levers were pressed down. However, if the "Monarch" were to come up astern, to ram a ship with the Harvey placed astern or on the quarter, and hung like a life-buoy, as proposed, the object being to use it on the defensive, she (the "Monarch") would have no protection against this application of the Harvey.

The Outrigger torpedo was tried in a steam pinnace. The ship had steam up, and slipped on a given signal. The pinnace came at her from some distance ahead, and was very nearly capsized by the hawsers, but was near enough to have exploded the torpedo in contact, or very near it.

The want of a protection of some sort for ships was evident in the last war, where a whole fleet was incapable of acting through fear of torpedoes. The French Fleet had to steam out to sea every night, to avoid outrigger torpedo-boats, and when they came in next day, it was almost time to start again. What evidently was required, then, was a more perfect protection, which could be quickly got out and in, allowing the ship to keep under weigh, moving slowly, if necessary, as in blockading a port.

I forwarded a plan to the Lords Commissioners of the Admiralty for this purpose—a wire netting, equal in depth to the draught of water of the ship, completely surrounding her. This was hung from iron-jointed outriggers, three on each side and one astern, the jibboom answering that purpose ahead. There were four joints in each outrigger, of flat iron, each joint ten feet. The Committee had made forty feet, a *sine qua non*. I endeavoured to find out the reason, but failed. I think that a less distance would do, especially as the "Oberon" experiments have clearly shown at what close proximity the charge must be to do any damage to the bottom of the vessel. These outriggers were supported by topping lifts and guys, and could be triced up or lowered, the mode of supporting them being merely a matter of seamanship; and, when not in use, they were fitted to fold up and stowed perpendicularly against the ship's side, and secured by lashings. The netting was rolled up and stowed in boom-boats amidships, so that it could be hoisted out with them and run round the ship, in an hour at most, the outriggers being got out and unfolded by another boat, as will be more fully described further on.

The Committee found fault with this plan on account of the non-rigidity of the outriggers and their insufficient number and strength (the two latter being merely a matter of detail), and they did not think it so good as a plan of their own, which they brought out about the same time. In their plan, which was tried on Her Majesty's ship "Glatton," the net was the same as above described, but hung by ship's spars, and was supposed to be got ready in twenty-four hours. The net flapped up under the bottom, with a tide about three or four knots, or moving ahead at that rate, when the net flapped up, the side was unprotected from the Whitehead, and the vessel was excessively unhandy, owing to the complicated arrangements. She was considered successfully protected against a boat, but not a gun-boat using an outrigger, as gun-boats of the "Comet" class are to be fitted with.

I proceeded to remedy the faults in my former plan, and trust I have successfully done so in the annexed diagram.

Fig. I is an elevation, showing an iron-clad ship (Her Majesty's ship "Bellerophon") with the wire netting hung by three-jointed outriggers, one on each side, one astern, and by jibboom ahead.

Fig. II is a plan showing outriggers in four lengths of ten feet each, made of gas piping (gas piping being used on account of great strength, lightness, and cheapness), supported by topping lifts from yardarms, guys, &c. The netting is supported between the outriggers by a span from yardarms, which, with the topping lifts, would enable the netting to be triced up, to effectually prevent any attempt to override them by outrigger boats. A wire rope goes round the ship, about ten feet from the netting, and a hawser ten feet inside that; these are a further support to outriggers, also a further protection against outrigger boats.

Fig. III is a section of a length of outrigger, showing the joint, the ends being tapped to receive solid metal plugs, through which pins are placed that the tongue works on, and allows them to turn up when not in use. The tubing which goes over the joint keeps the outrigger rigid, and when the outrigger is not in use, the tubing is pushed back and the pin put in, to keep it in place, as shown in Fig. IV of outrigger stowed for sea.

Fig. V shows the stay for keeping the netting perpendicular. The rod B A is small and solid, and goes in and out of different meshes, as shown in Fig. 1. A D is the same size as B A, and works as shown in Fig. IV. B C D is the ordinary outrigger of gas piping, but is shown small and same size as B A and A D, to show the idea more clearly.

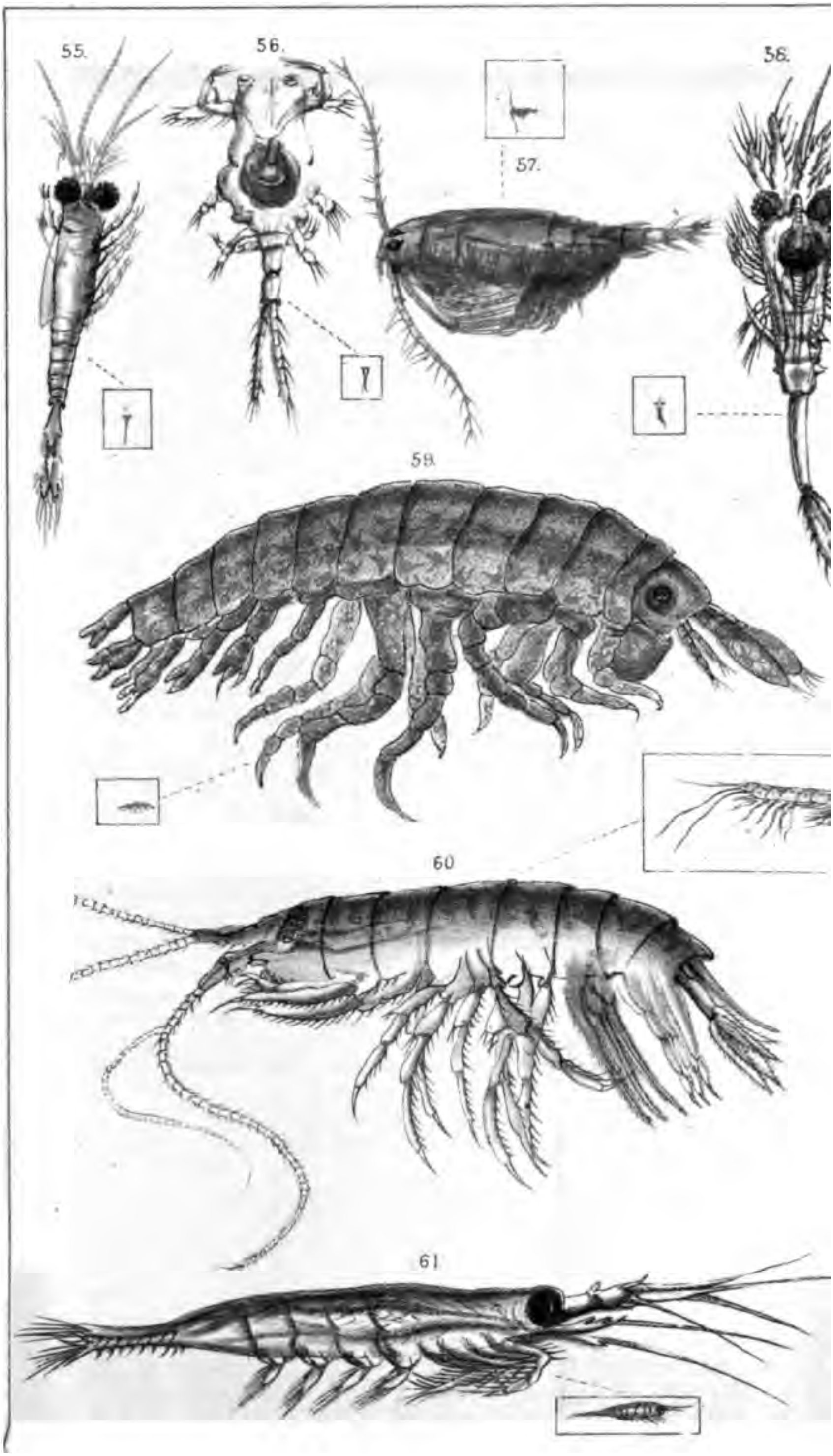
This gets over the failure in Her Majesty's ship "Glatton," of the net flapping up under the bottom.

A Whitehead torpedo striking this netting will explode, and merely damage the net at that place. This has been found out by actual experiment.

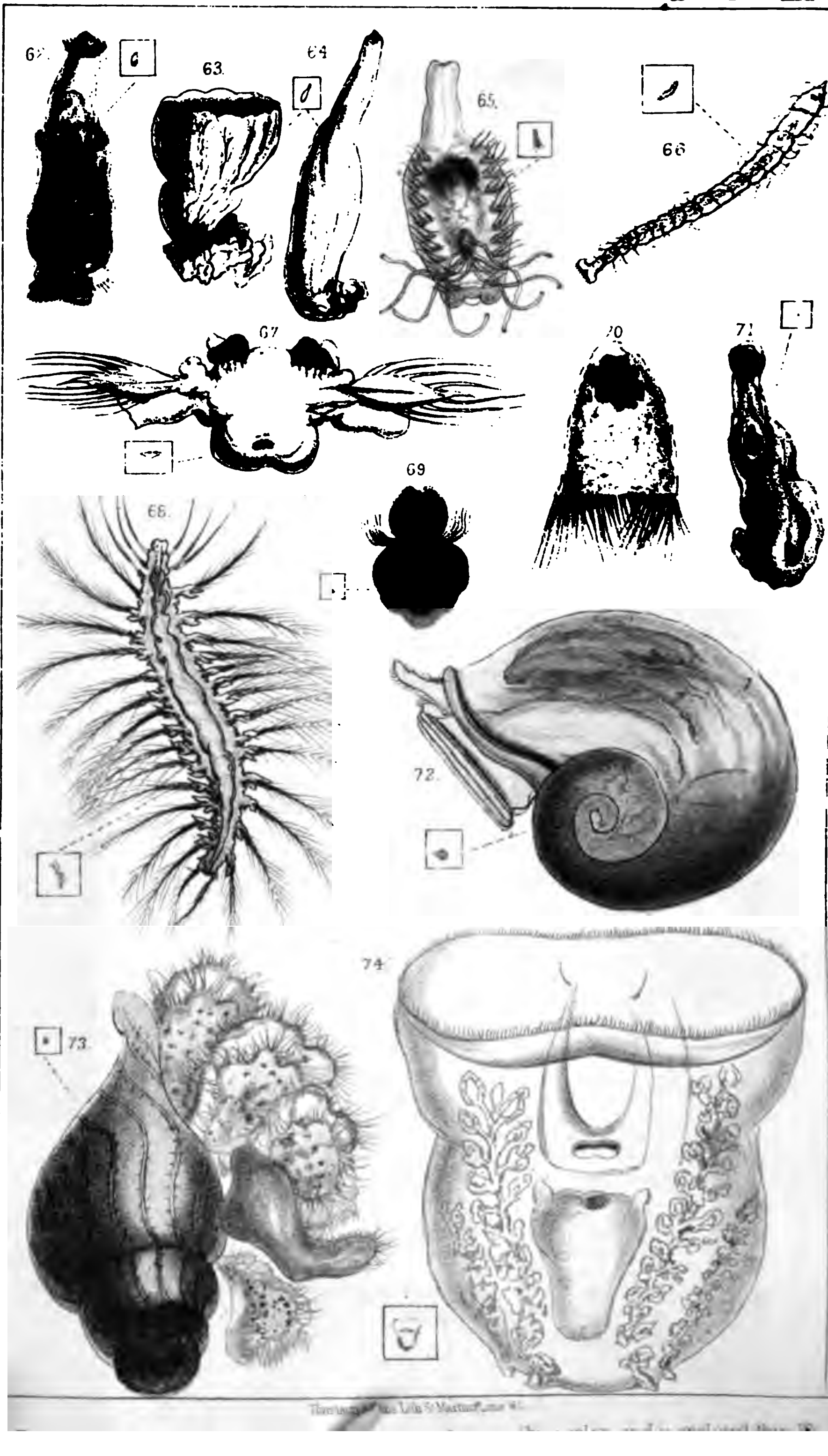
When the ship is at sea and outriggers are not in use, they are folded up and lashed against the ship's side, as in Fig. III. They would not be in the way or unsightly.

The netting, which is the same depth as the draught of the ship (certainly not more than 28 or 29 feet), would be rolled up in lengths, as convenient. The netting for each side of the ship being in two lengths, would probably suit best for a large ship, the diameter of the roll for 50 yards being about 18 inches. These rolls I propose stowing two in each boom-boat amidships, the length of the roll being 12 to 15 feet less than the length of the boat, they could be stowed easily.

On arriving off an enemy's port, and wishing to remain under weigh for blockading or other purposes, the boom-boats would be hoisted out and netting run round the ship; another boat each side assisting to place the outriggers and secure the netting to them. The boats would then be hoisted in again, and the ship steam slowly (from three to four knots at least), as required. The anchor might be let go, if necessary, and guard-boats placed round the ship. It would be



Harrison & Sons Lith St Martins Lane W.C.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advisable to have "service hand-charges" and other appliances suitable to the situation in them, which would effectually dispose of any of the enemy's boats that approached.

The ship ought also to have several 20-pound Armstrong's, loaded with case, and given extreme depression, so as to strike the water at about the end of outriggers; these guns should be kept loaded.

When required to go to sea, the boats will be hoisted out, the netting got in, and the outriggers secured, as already described. It would certainly not take more than one hour to rig and half-an-hour to unrig.

DELINEATIONS OF SOME MINUTE SEA-SURFACE ANIMALS.—From Coloured Drawings by Mrs. TOYNBEE.

PART III.

(*Continued from page* 379.)

For instructions regarding means of capture, examination, &c., see page 214.

PLATE V.

Fig. 55. April 23rd, 1857. Lat., 23.29 S.; long., 3.33 E. Temperature of surface water, 67°. This larva crustacean was taken by the net from a very phosphorescent sea, but died before it could be examined.

" 56. March 6th, 1857. Lat., 0.57 S.; long., 82.49 E. Current, N., 30 E., 25 miles. Temperature of surface water, 81°. *Copilia mirabilis.* The striped claw on each horn was very distinct.

" 57. *Anomalocera, Crustacea, Copepoda.*—March 28th, 1857. Lat., 29.22 S.; long., 44.55 E. Current, S. 74 W., 5 miles. Temperature of surface water, 73.9°. The eyes appeared to be multiplex, and the circles on them moved regularly to and fro like a piece of machinery.

" 58. *Larva?*—No description.

" 59. *Crustacea, Amphipoda.*—Nov. 13th, 1856. Lat., 32.42 S.; long. 76.19 E. Temperature of surface water, 62°. Crustacean found in a jelly fish. It appeared to respire by a quick movement of the hind legs. In the legs there was a distinct circulation of a colourless fluid containing a few corpuscles, the fluid running down one side of the leg and up the other.

" 60. *Crustacea Amphipoda.*—April 17th, 1857. Lat., 31.13 S.; long., 13.18 E. Current, N. 65 W., 7 miles. Temperature of surface water, 63°. Pumped up this shrimp, as it may be called; it was probably brought by the northerly current into the deep sea.

" 61. *Larval Crustacean.*—Jan. 9th Lat., 16.18½ N.; long., 82.22 E. Temperature of surface water, 75.5°. This was caught in the bucket from about a depth of ten fathoms. It kept its legs in very rapid motion. Its eyes were multiple, it does not seem to belong to the deep sea.

PLATE VI.

" 62. *Larval Holothurioid?*—May 17th, 1858. Lat., 35.26 S.; long., 18.40 E. Current, N. 78 E., 2 miles. Temperature of surface water, 65.3°.

Caught two of these larvæ in the bucket; in both were detected wings as they flapped quickly through the water, though when placed under the microscope there was no sign of them; nothing was in motion save the active ciliæ and the incessant contraction and expansion of the flexible body, especially at the upper end.

Fig. 63-4. April 9th, 1857. Lat., 34.59 S.; long., 19.55 E. Current, S. 64 W., 14 miles. Temperature of surface water, 64°. Caught this holothuria? in the net, besides numerous crustaceæ. Its first appearance was cup-shaped, as in Fig. 63, then changed its form by projecting its mouth as in Fig. 64; after working it actively for some time with a kind of sucking motion, it drew itself into a ball and died.

„ 65. Oct. 6th, 1857. Lat., 12.06 N.; long., 26.49 W. Current, N. 49 W., 28 miles. Temperature of surface water, 80°. Nearly calm; caught two. The ciliæ and long feelers were kept in very active motion, and the sucker-like mouth contracted and expanded.

„ 66. *Phyllozoa?*—Dec. 14th, 1857. Lat., 9.35 S.; long., 82.47 E. Current, S. 66 W., 24 miles. Temperature of surface water, 81°. The side paddles of this annelid all seemed to consist of two pieces as shown in enlarged drawing.

„ 67. *Monosomatomatous Worm?*—Nov. 23rd. Found this worm, which swam freely in the water, though when placed in a drop of water under the microscope it was very quiet.

„ 68. *Annelida, new form?*—March 9th, 1857. Lat., 7.35 S.; long., 84.11 E. Current, N. 45 E., 17 miles. Temperature of surface water, 80.4°. This annelid moved through the water with a wriggling motion, moving its fins rapidly.

„ 69. *Annelid Larva.*—April 9th, 1858. Lat., 12.48 S.; long., 74.30 E. Current, N. 24 W., 17 miles. Temperature of surface water, 81.2°. This larva was very active, darting about and working its ciliæ. When under the microscope there was no trace of internal formation, eyes or mouth, the whole looked one soft contractile, elastic mass.

„ 70. No description.

„ 71. Dec. 26th, 1857. Lat., 1.05 S.; long., 85.13 E. Current in two days, S. 73 E., 58 miles. Temperature of surface water, 81°. Caught this creature which moved about its large mouth, contracting and expanding its body, the dark mark on the body looked raised and hard.

„ 72. Dec. 24th, 1857. Lat., 4.03 S.; long., 82.11 E. Current, S. 25 E., 19 miles. Temperature of surface water, 80.9°. Found this shell; it was very light, floating on the top of the water.

„ 73. *Macgillivrayia, or Cheletropis.*—April 27th, 1858. Lat., 29.30½ S.; long., 45.32 E. Current, S. 42 E., 9 miles. Temperature of surface water, 76.7°.

„ 74. April 22nd, 1858. Lat., 27.29 S.; long., 52.51 E. Current, N. 2 E., 22 miles. Temperature of surface water, 75.1°. This delicate little medusa worked its crown of ciliæ actively.

The Journal

OF THE

Royal United Service Institution.

VOL. XIX. | 1875. | No. LXXXIII.

Evening Meeting.

Monday, June 14, 1875.

Admiral Sir HENRY J. CODRINGTON, K.C.B., in the Chair.

NAMES OF MEMBERS who joined the Institution between the 1st and 14th June, 1875.

ANNUAL.

Hewett, Edwd. O., Major, R.E. | Reece, Fredk. L. C., Lieut., R.N.

MANCE'S HELIOGRAPH, OR SUN-TELEGRAPH.

By SAMUEL GOODE, Esq.

THE duty I have undertaken this evening of offering a brief explanation of the construction and use of the Heliograph would have devolved more appropriately upon its inventor, Mr. Henry C. Mance, of the Government Persian Gulf Telegraph Department, but as he is on service in India, and is consequently prevented from appearing before you, I have been induced to attempt it for him. Beyond the fact that the invention has been placed by Mr. Mance in my charge, and that I have had some practical acquaintance with its working capabilities, there is nothing to justify me in addressing an assembly like the present on a subject in which so many purely military questions are involved. I have, however, been put in possession of the results of the numerous experiments made by Mr. Mance, and have had the further advantage of reading the reports of the several skilled officers to whom the instrument has been entrusted for trial by the Government of India. It is upon the facts embodied in these reports that the suggestions I may venture to offer as to the adaptability of the instrument to military uses are chiefly based, and if I travel into further inferences, I beg you to regard them as submitted to the consideration of those of my hearers who may do me the honor to refer them to the test of their own knowledge and experience. My chief encouragement lies in the hope that the merits of the instrument will in some measure make up for all defects in its description. I should have no doubt on that point if this meeting had been assembled on a clear sunny after-

noon on Dover cliffs to conduct a conversation through its instrumentality with another party similarly equipped at Calais. To those who have not studied the phenomena attending the reflection of sunlight, first experiments with the heliograph could not fail to be interesting. The most astonishing of them is the immense distance at which the flash can be seen, bright and distinct as a planet, which in appearance it very much resembles. Many of my hearers will scarcely be prepared to credit that signals from the smaller of the instruments before them, which has a mirror of 4½ inches diameter, are clearly visible under favourable atmospheric conditions, without the aid of a telescope, at 25 and 30 miles; while from mirrors of 8 and 12 inches they are equally clear at 50, 80, and even 100 miles. The fact is so startling when brought home to one by experiment, and in combination with an apparatus by which the flashes can be truly directed, and so made to appear and disappear as to represent words, that the judgment is liable to fall captive to the imagination in forming an estimate of its practical value. For here is an instrument giving any person of intelligence the power, after a few hours' instruction, of transmitting messages at a rapid rate in any direction and to any distance, which is in fact a complete telegraph without batteries or wires, as portable as a rifle, and only about half its weight.

Experience soon shows, however, that on ordinary occasions its utility is greatly circumscribed by the necessity of two conditions which do not always exist, especially in a climate like that of England, viz., the presence of sunshine and the absence of obstacles between the points of communication. But before entering on the advantages or disadvantages attending its use, I will ask your attention to the construction of the instrument.

The heliograph consists of a mirror mounted on a suitable stand, with adjustments to revolve and incline it so that the sun's rays can be reflected with ease and precision in any required direction. The horizontal movement is obtained by a tangent-screw in contact with a wheel, on the axle of which is also a revolving plate carrying the mirror; the vertical inclination is altered by screwing a steel-rod through a nut attached to the top of the mirror. Both adjustments are so constructed as to admit of the reflection being thrown at once approximately true, then absolutely so, and so kept, notwithstanding the ever changing position of the sun. By pressing the tangent-screw outwards it is removed from contact with the wheel; the plate is then revolved freely by the hand to the required place. The rod attached to the top of the mirror, slides into a cylindrical handle at the back, until the desired elevation is attained; it is then clamped, and by a slight movement of the tangent-screw or the rod the lateral or vertical inclination of the mirror can be adjusted to the utmost nicety. The cylindrical handle is connected by a ball-socket-joint with a lever attached to the revolving plate, so that the lever handle and rod together form a finger key. The depression of this key slightly alters the inclination of the mirror, which is restored on the pressure being removed by a spring beneath the lever. Thus by the action of the finger-key the reflection of the mirror can be thrown on and off any

given spot, and by varying the duration of the pressure, the flashes are made long or short. By combining these long and short flashes, which are equivalent to the dashes and dots of the Morse Code, the letters of the alphabet are indicated, and the transmission of verbal messages is made possible. Good signallers can send them at the rate of twelve or fifteen words per minute. A very simple means is adopted to ensure the flash being directed truly. It will be observed that a small portion of quicksilver is removed from the centre of the mirror, giving it the appearance of having a hole in it. Through this the signaller looks toward the station with which he wishes to communicate, while a sighting rod is set up about ten yards before him in a true line with it. A metal stud, answering to the sight of a rifle, is then slid upwards or downwards on the rod until the centre of the mirror, the stud, and the distant station, are truly aligned. This done, however much the mirror is revolved, the alignment is never disturbed, inasmuch as the centre, being the axis on which it moves, is stationary. It follows as a matter of course that when the flash from the mirror is thrown on the stud it is in a right line with, and is visible from, the station beyond, at which it is directed. The signaller has therefore only to take care that the flash rises to the stud every time the finger-key is depressed. The observer has merely to look towards the signalling station, when a succession of bright star-like appearances meets his gaze, which he can readily interpret into words. On the sighting-rod slides also a short cross bar. It is placed at the same distance beneath the stud as the pressure of the finger-key rises the flash on the rod, and so that, when the mirror is at rest, the flash falls on the bar, its centre coinciding with the point of intersection. As the position of the sun alters, the flash would gradually move from this central position, to which it must be preserved by a slight turn at intervals of the tangent-screw and vertical adjustment. The rod thus serves as an object on which to throw the flash, and thus of ascertaining its whereabouts; it also affords a means of directing the flash truly. Both rod and bar are usually made of white wood, the reflection being more visible on a white than on a dark substance.

It is evident that if it were required to send the flash in a direction precisely opposite to the sun, a difficulty would arise, but it is easily obviated by employing a second instrument, its function being to reflect the rays back into the first, which then flashes them to the required spot with as much ease as if no intermediary had been employed. A second apparent difficulty—that of making a true alignment with a station twenty or fifty miles off—has in reality no existence. It is easy to attract the attention of a look-out, however distant; he responds with a rightly directed flash from his instrument, and at that starlike appearance, the original signaller aims with as much ease as he would at the moon.

It may be added, that as the vertical adjustment forms part of the finger-key, the movement necessary to obviate the changing position of the sun can be made while in the act of signalling, one hand being also at liberty to control the tangent screw.

The next subjects on which, I think, you will desire some further

assurance will be, first, the range of the signals, and secondly, their intelligibility. The official reports are very explicit on both particulars. And here I must explain that Mr. Mance, being on service in the Bombay Presidency, brought his invention as early as 1869 to the notice of the Government of India, who submitted it to every form of practical test. In a letter, dated 16th April, 1873, Colonel Roberts, C.B., V.C., Quartermaster-General, writes, "I am directed by the Right "Honorable the Commander-in-Chief, to submit, for the information "of Government, a printed copy of a memorandum, embodying the "results of the several experiments and trials which have been made "to test the efficiency of the heliograph invented by Mr. Mance, as a "means of signalling for military purposes. The Commander-in-Chief "is satisfied that the instrument even in its present form" (it has been vastly improved since then) "would, under certain circumstances, "and where the electric telegraph is not available, prove of great "value in the field, and His Excellency is of opinion, that six or eight "heliographs should be made and stored up with the field telegraph "train at Roorkee, some men of the sappers and miners being kept "constantly practised in the use of the instrument," and while "His "Excellency does not consider the heliograph would be substituted for "flags," he observes, that "it is an instrument adapted for a special "end, and as such is extremely valuable." With respect to the two questions of range and distinctness, the memorandum above referred to says, "All the reports agree in the following points: (*a*) that the "signals given by it are perfectly clear and satisfactory; and (*b*) that "they can be easily read in ordinary weather without telescopes up to "50 miles."

The capabilities of the heliograph are therefore thoroughly established. My desire, this evening, is to draw attention to the subject of sun-flashing generally, and to show how well its study will repay Officers, especially those on foreign service, by whom the heliograph can be made available, not only in cases of emergency to which they are always exposed, but in their every-day life. I am informed that a Staff Officer at Poona, who had a country house about twenty miles distant, used, when there, to go by appointment at a fixed hour to a certain window to receive and reply to messages flashed to him from Poona, and so conducted his official business. This is but one illustration of the adaptation of the instrument to daily requirements; it is not difficult to divine the thousand and one purposes it might be made to serve at a detached Indian hill station, by uniting it with surrounding stations and the plains. But to return to the memorandum, bearing the signature of Captain Collette, D.A.Q.M.G.: "Messages can, under favourable conditions, be signalled distances up to 50, 80, or even 100 miles, without "using telescopes. Even during very hazy weather signals from Shaik "Bodeen were quite distinct to the naked eye at Dehra Ismail Khan, "a distance of 38 miles, although the hill itself was barely visible. "With telescopes and suitable mirrors (6 or 8 inches) there seems to "be hardly any limit to the distance at which signalling could be "carried on." A little consideration will convince us that the latter remark is no exaggeration. The sun's light reaches us through say

92,000,000 miles, whether a million or two more or less the *savans* who recently observed the transit of Venus will perhaps shortly decide for us. Is it too much, then, to believe that after such a journey, the rays preserve sufficient vital force to carry them a hundred or two miles further? Striking a mirror simply alters their course, bends them to a new direction, but makes little difference to their energy. We have a practical illustration of the fact in the moon, which, though not perhaps the best reflector, projects the sun's rays to us from a distance of 232,000 miles. The planet Neptune is three times the distance from the sun the earth is, yet the solar rays reach it and are reflected back to us. Abundant illustration of the immense distance at which reflected light can be seen might be afforded from terrestrial objects, but it is, I feel unnecessary.

The knowledge of the potency of sunlight as a signalling agent is at least as old as Alexander the Great, whose fleet is said to have been guided along the Persian Gulf by mirrors, during his invasion of India. I am informed on good authority that signalling by sun-flashes is practised by the Indians on the North American prairies to this day; and the Russians had recourse to it during the siege of Sebastopol in 1854–5. But from Alexander of Macedon to Alexander of Russia little progress was made in this kind of telegraphy; indeed it had fallen into disuse, when, towards the close of last century, General Roy employed it in the operations he conducted to connect the meridians of Paris and Greenwich. Out of those measurements sprang the great trigonometrical survey of the United Kingdom, but recently completed. During the early periods of that survey, it was customary to burn Bengal lights or Argand lamps, at night, on the distant points of which the bearings were required. The very limited range thus obtainable, and other practical difficulties, led that very ingenious officer, Captain Drummond, R.E., to an adaptation to survey work of what is now known as the lime-light; and so efficacious was it found, that during the survey of Ireland, in 1825, a range of 66 miles was obtained from Slieve Snaght, in Donegal, to Divis Mountain, near Belfast. But a far more powerful agent than the Drummond light was about to be called into service. The manner in which General Roy employed reflection is not recorded, but in 1822–3, Colonel Colby, R.E., who was then conducting the survey, devised a sun-flashing instrument, which, though exceedingly primitive, was attended with much success. It consisted of a stout plank, on the face of which was nailed, one below the other, several plates of polished tin, at angles calculated to reflect the sun's rays for a considerable time in the same direction, notwithstanding his apparent movement. The idea of sun-flashing being thus revived, Captain Drummond's inventive powers were brought to bear, and he succeeded in producing an instrument far more effective for the purpose than Colonel Colby's tin plates. Taking a plain mirror as a reflector, he devised means for adjusting it to any position, and, by a combination of telescopes, of directing the flash truly. This highly ingenious, but delicate and complex, instrument he called a heliostat. Its power was marvellous; the Surveying Officers were enabled by its means to make their observations at three times the distance they could previously,

with much greater ease, and with far less liability to error. It was soon found possible to reduce the complexity of the instrument; the telescopes were dispensed with, and other modifications made, until it assumed the form it has ever since retained, which, though comparatively simple, still requires an expert with a theodolite to direct it. How far these modifications were influenced by the heliostat invented about the same time by Professor Gauss, and employed by him in the survey of Hanover, I am unable to say; but what the heliostat then became it has ever since remained. Its function is to throw a steady flash of light between distant points, to enable surveyors to take their relative bearing, and for this purpose it has been in constant use in all great trigonometrical surveys throughout the world. The map, issued to illustrate the survey of the United Kingdom, shows the hundreds of triangulations which were made by means of the heliostat in the course of that operation. Many of the points of observation are from 60 to 100 miles apart; and in the case of the triangle formed by Scaw Fell in Cumberland, Slieve Donard in Ireland, and Snowdon in Wales, the sides are 111, 108, and 102 miles respectively. This fact is worth bearing in mind in connection with the range of sun-flashes in northern latitudes.

The heliostat is, however, in no sense a talking instrument; it is neither designed nor employed for that purpose, although the strong desire of facilitating operations by communicating with their distant colleagues has doubtlessly led surveyors occasionally to the expedient of making pre-arranged signals to each other. The heliostat had been in use nearly half a century when the happy thought occurred to Mr. Mance of converting rays of light, which had previously been regarded in a signalling sense as entirely passive, into active speaking agents. This he did by adapting to a mirror, mounted somewhat similarly to the old heliostat, a means of imparting to the reflections the character of pulsations of varied duration, in accordance with the Morse code. In fact, in furnishing his instrument with a finger-key, he gave it a tongue capable of distinct and effective utterance; he also found it a language in which to speak, the Morse code. As the celestial bodies have already been used as illustrations, I may refer to them again. The difference between a heliostat and a heliograph is the same in principle as if the moon, instead of the steady reflection she has hitherto given us, were to make her light intermittent, sending it at short, well-defined intervals, in deference to a sudden desire on the part of the man, her occupant, to communicate with sublunary mortals through the medium of the Morse code. The heliograph is, however, as applicable to all forms of survey work as the heliostat, besides being adapted to verbal intercourse.

Whether the means adopted by Mr. Mance for directing the flash of a mirror, and converting it into articulate language, is the best that can be employed, time will show. Other forms will doubtlessly be attempted, with which other names may be associated. It is seldom that an invention springs into life absolutely perfect. It is due to Mr. Mance, therefore, to call attention to the fact that, until the appearance of the heliograph, no effective speaking, sun-flashing instrument was known to the world. In proof of this, it is only

necessary to refer to the important crises which have passed without its employment. To take a recent example. If the heliograph had been in use in the French Army during the siege of Metz, it would have been possible for Marshal Bazaine to have kept up communication with the Armies in the field operating for his relief, despite all the efforts of the besiegers; and had this been done it is certain that, whatever other fate may have befallen France, she would at least have been spared the disaster at Sedan.

In case of siege, the heliograph possesses one marked advantage over the electric telegraph. The latter is certain to be rendered inoperative at once by the destruction of the wires. The heliograph is liable to no such interruption. The limit of its range is dependent only on the elevation at which it can be placed. It can signal to any and every spot round the compass in succession over the heads of the besiegers, who are not only powerless to intercept it, but might not be conscious of its existence, as the flashes cannot be seen a little distance from the true line. It may be observed, too, that signals can be sent into a besieged city as easily as out of it, a result not obtainable by pigeons and balloons. The heliographic conditions were not so favourable at Paris as at Metz, but if communication could have been established between the city and General Chanzy, when he approached so near to it with the Army of the Loire, it is next to certain the siege would have been raised. Again, during the Sepoy mutiny, what a consolation would it have been to the devoted garrison of Lucknow to have been informed of the approach of the gallant Army which ultimately fought its way to its relief, and also to that Army to have known how long the garrison could hold out. The mutual assurance could have been given by the heliograph with ease. In fact, a much simpler instrument than the heliograph would have sufficed. The requisite flashes could have been sent by an ordinary hand mirror, as they could also have been sent at Metz and Paris. But the thought of converting the sun's rays into speaking messengers had not then been born. It was much easier to find a hero, like Kavanagh, ready to risk the most horrible of deaths in making his way through the myriads of relentless foes surrounding the city, than to call into existence a new mechanical agency. Next to the invention of the heliograph itself, the most important service rendered by Mr. Mance has been the persistency with which he has advocated the use of sun-flashing in connection with the Morse code, until at length the attention of the Indian Government, and of signalling Officers generally, has been thoroughly roused, and in new emergencies it will not, I feel assured, be forgotten.

But, without looking farther into the past for illustrations, which every Officer who has been on active duty will be able to supply, I may refer to the vital importance that would attach to the heliograph in case of another mutiny or general uprising of the population in India. The first attempt of the insurgents would be a general cutting of wires and tearing up of rails throughout the country. The fighting value of the comparatively few British forces scattered over India depends, in no small measure, on the existence of easy means of communication between the different military stations, thus knitting the

detached corps together, giving them timely warning of danger, and common action against their enemies. With telegraphs destroyed and garrisons besieged, unanimity of action would be impossible. Over such a vast area as India flag-signalling can be of little value, but a well developed heliograph system would preserve to the forces an inalienable power of holding rapid communication from one end of the country to the other. I need not say that the instrument which could ensure this, in such a crisis, would be priceless, and the possibility of the contingency arising, would in itself seem to justify the training of the signalling corps at home and abroad in its use.

The value of the heliograph is, however, by no means confined to great and rare emergencies. The tripod instrument before you, which weighs, with cases and stand complete, but 5 lbs., has been constructed with special reference to ordinary service in the field. "It is of great importance," says Sir Garnet Wolseley, in the Soldier's Handbook, "that outposts should be able to communicate "by signals with the main body, and that officers in charge of patrols, "reconnoitring or flanking parties, advanced or rear guards, should "have the power of rapidly communicating with the General what "they observe, or the intelligence they may obtain." The question to be determined is, whether the heliograph does or does not afford additional facilities for securing that communication, on the importance of which Sir Garnet insists. I use the word *additional* advisedly. There is no desire whatever to depreciate or displace any of the signalling agents at present employed. On the contrary, great pains have been taken to render the heliograph so light, handy, and portable, and so little subject to damage, that it may be added to the present signalling equipment without being felt as an incumbrance. The possibility of its extraordinary powers being called into requisition, might be thought to justify its being taken into the field on all occasions; but if the conditions were not favourable, the signalling means at present employed could still be used.

There are circumstances under which none of the existing systems are applicable, yet which the heliograph would meet. It may be well, however, to say here a few words respecting the radical defects of sun-flashing and of visual signalling generally. "What is the good," it may be asked, "of expatiating on the merits of an instrument, the use "of which depends entirely on the presence of the sun. In England "sometimes the sun does not shine for weeks together, and when it "does, just at the moment a signal should be made, a cloud would possibly obscure it, or some intervening object prevent the flash from "reaching its destination?" To such objections I would reply that the heliograph is not put forward as an independent or perfect signalling instrument. The telegraph, though by far the most valuable of all signalling agents, is far from being perfect. "The electric tele-"graph is constantly liable to interruptions in war," writes the distinguished authority before quoted, and I may venture to add, it is costly in money and men to produce, transport, lay and protect when down. Hence, and because it can only signal in the direction of the wires, its use in the field is very circumscribed, being employed in none of the operations before mentioned as the objects of signalling.

It is essential, therefore, as Sir Garnet proceeds to point out, to have the power of supplementing it; and the utility of flags is warmly dwelt upon by him. But neither are they perfect. Flags are limited in range, slow and laborious in manipulation, they can be used only in specially selected positions, they are exposed to the observation of foes as well as friends, and in large operations are confusing from their number; they also require special atmospheric conditions and the absence of intervening obstacles. Indeed, free range, one of the two requirements of the heliograph, is obviously essential to every form of visual signalling; and if the second, viz., favourable atmospheric conditions, be not also existent, flags and similar devices are of but little use. Thus in rain, snow, and fog they are on a par with the heliograph, and in dull English weather, it is questionable if much advantage attends them, owing to the limited range attainable. The objections to the heliograph apply more or less, therefore, to every form of visual signalling; but it is scarcely fair to urge that, because it is not adapted to the English climate, it is not suited to English wants. The training and equipment of the Army is not directed exclusively against invasion. It is a long time since a foreign foe set foot on our shores, and it will probably be a long time ere one does again. Our fighting has been done chiefly where there is no lack of sunshine, in India, China, Africa, and similar climes, in which the objections to the heliograph lose all their force.

Allowing, therefore, that practice with the instrument may be attended with difficulty at home, no such difficulty exists where the Army is likely to be actively employed, and where about half of it is permanently stationed. It cannot be presumed that the training of the forces abroad is not as important as of those at home.

It has already been observed that, in combination with infinite disadvantages, the heliograph is, when compared with it in one or two respects, superior to the electric telegraph. In comparison with flags, it excels in range, speed, ease of manipulation, secrecy, less liability to confusion, and the capability of making itself seen. This last quality is, I think, deserving of special consideration. I understand that if flag-signallers are not placed with great care their motions cannot be discerned, while the flash from a heliograph at once commands attention. It is not necessary to choose for it a position against the sky line, or any particular kind of back ground, the signaller may be quite hidden, and not more than his general whereabouts known; his station may even be completely obscured by haze or mist, but the moment the flash of his instrument is truly directed it is strikingly visible. It is on this account not less than on its great range that it is believed to be so well adapted to assist in securing that "communication between "patrols reconnoitring and flanking parties," which is manifestly of such great importance. To further illustrate its possible use in field operations, if you will kindly pardon the evident want of strategy, and grant an eastern instead of an English climate, I will suppose an army lying in the neighbourhood of Sydenham, for the protection of London from an invader advancing from the south coast, and that reconnoitring parties have been sent to occupy at intervals the line of

hills from Sevenoaks to Epsom Downs. It is probable that not one of those parties would lose five minutes in making itself known, and establishing communication with head-quarters. And further, should the necessity arise for issuing new orders to the advanced parties, no longer time need be occupied in finding them out. The construction of the instrument is admirably suited to the accomplishment of such purpose. Pressing the tangent screw out of contact with the wheel, the mirror would be revolved slowly by the hand across the arc in which it was probable the out-party was. This being done twice or thrice at one elevation of the mirror, a turn of the vertical rod would admit of the process being repeated at another elevation, till by gradual changes every inch of ground had been searched and the outpost discovered. This power of establishing communication being admitted, I would submit whether the heliograph may not be found occasionally of much service to mounted reconnaissance parties. As conducted at present, if the party happens to fall into the hands of the enemy, the whole object of the expedition is lost. But if any member of it carried a heliograph, as intelligence was obtained it would be flashed back to head-quarters, and thus not only would valuable time be gained, but if any misfortune subsequently befel the party, the loss would be mitigated, as its purpose would have been served.

It will be observed that the only essential parts of the instrument, the mirror and adjustments, are removable; they weigh 1½lbs., and by making the carbine or lance of a mounted man serve as a stand in the same way as the instrument has been fitted to a walking stick for the use of travellers, that would be the only additional weight imposed. But by folding the tripod legs, the instrument, ready mounted, may be carried in front of the saddle without inconvenience. It is made in any of these forms by Messrs. Elliott Brothers, Strand.

The official memorandum I have before alluded to, thus sums up the military value of the instrument as then discovered:—

"On the whole, it appears to me that while the heliograph will "never supersede, or be substituted for flags, it may with great ad-"vantage supplement them; flags are so easily made, so portable, and "so efficient for the ordinary signalling required at the outposts, &c., "of an Army, that nothing better can probably be devised; but it is "exactly where flags fail that the heliograph will be found useful. "In India we cannot, I fear, expect to have telegraphic apparatus "always at hand; and it is where a telegraph line would be so "valuable that three or four heliographs might be worth their weight "in gold, viz., to connect a force operating in the hills or elsewhere "with the nearest electric telegraph station. For instance, during "the Umbeyla campaign, a heliograph on the Crag Picquet, and "another at Permoulie, would have been found very useful; and in "Abyssinia, where for *want of wire* the electric telegraph stopped at "Antalo, a few heliographs would have extended the means of almost "instantaneous communication up to the walls of Magdala. As it "was, mounted orderlies had to be used to convey messages along "this part of the line."

The adaptation of sun-flashing to maritime affairs ought not to be

altogether overlooked. It might be employed from lighthouses and headlands along the coast in defensive operations, in coast-guard service, and for reporting the passing and arrival of vessels. Under favourable circumstances, too, I think it not impossible that directions could be flashed from the shore to boats and shipping at considerable distances, and if so, a wider scope would be given to it.

But to whatever extent the heliograph may be employed in military and naval operations, it is, I think, as a substitute for telegraphic communication in the ordinary affairs of life that it will be most appreciated. In many tropical countries where the laying and preservation of wires would be unremunerative, the heliograph is calculated to afford to the inhabitants most of the advantages of an electric telegraph, both as a means of internal communication, and to join them to distant commercial centres. It is not many years since the most civilised countries had to depend entirely on visual telegraphy. Many of my hearers will remember when semaphores were in universal use and esteem. The heliograph is infinitely superior to the semaphore, and, in tropical countries, its ability falls little short of an electric wire, inasmuch as besides being available throughout the day, by the application of artificial light, it can be used also at night, when both position and light being constant, one adjustment of the instrument is sufficient. With moonlight, also, it is very efficacious. In commercial cities to which telegraphs have not as yet been largely applied, it may be employed instead of the expensive underground and aerial wires. In countries where trunk lines only are laid, the heliograph will act as a feeder, bringing outlying parts into communication. It may further be employed in establishing communication along the frontiers and coasts of a country, and in an infinity of other ways to which I need not allude. Remembering that I am addressing a military audience, I have confined my remarks chiefly to the military uses of the instrument; and if I have succeeded in awakening attention to the subject of sun-flashing generally, and to the heliograph as a means of utilising it, I feel assured that it will be found a beneficent agent in emergencies yet unthought of.

Mr. Greaves: Some years ago I came across a volume of Galton's Notes of Travel, in which he describes how the North American Indians speedily availed themselves of this principle. They had found out the use of a mirror and from a lofty range of mountains, through gaps in the forest they had made use of a piece of glass to flash many miles across the country, a signal of their intentions and ideas, to another body of Indians in ambuscade at a distance. That was the most primitive use I have found of this principle. The Plain of Canterbury, in the middle island of New Zealand, extends some two millions of acres straight across to the mountains, and I have often noticed the position of a house on the mountains, simply by the rays of the evening sun striking on the panes of glass. I was at that time doing duty as a warden of the Trinity Board, and the idea suggested itself to me that the principle might be applied to our lighthouses. We have a lighthouse at the entrance of Port Lyttleton, in Canterbury, at an elevation of 480 feet, and the idea suggested itself to me, that the men in charge of the lighthouse by this method, might communicate with ships in the offing and pilot-boats by day or by night, by day with the light of the sun, by night with the artificial light; and in reading the Year Book of facts, I found that a flag staff that had been erected in Kew Gardens, of a great height, was finished with a glass diamond cut in facets, at

the top, and that from these facets the rays of the sun could be seen at great distances in the neighbouring counties. I think that the whole argument speaks for itself. It is the simplicity of nature, and it is so valuable that it is a wonder to me how it has remained in abeyance so long and has not been utilized.

Extract from a letter in the *Times*, of July 16th, 1855, from Charles Babbage the Philosopher, author of the Calculating Machine:—

"I have also evidence that the occulting system of lights was known at St. " Petersburg in 1853, and I infer that it has been practically applied at Sebastopol, " from the following extract from a letter of your correspondent at Balaklava, " *Times*, July 11th.

"'A long train of provisions came into Sebastopol to-day, and the mirror "'telegraph, which works by flashes from a mound over the Belbeck, was exceed- "'ingly busy all the forenoon.'

" This can scarcely apply to any other than *an occulting telegraph*."

Extracted from *Good Words*, 1873, in an article on "Lighthouses of the Future," by Sir William Thomson, LL.D., F.R.S.

Lt.-Colonel WILKINSON, 16th Lancers: Will you allow me to say a word or two? The remarks that have been made at present this evening on this subject, have been in favour of this invention, and having used it myself for the last two years, I feel bound to say that there are some points to be raised against it. Nature is constantly cutting off your line of communication. A passing cloud is quite enough to interrupt the most important message; there is no means at hand to restore communication, and at the critical moment of a battle, your whole plans are disarranged by a cloud over the sun. This is an evil of such great magnitude, that it at once places sun-signalling in the second class. Besides this, even a shower of rain will interrupt it, and when we remember that in India (which is our best field for this very instrument) operations are usually, if possible, conducted in the cold weather, when it is not at all unusual to have cloudy skies, the instrument is frequently for days of no use. There is one thing in its favour which has not been urged this evening, namely, that it can be used at night with the full moon, which gives very clear and most pleasant signals visible without the use of any glasses, for a considerable number of miles; one argument in its favour, that of being seen at *very* great distances, is modified by the fact that there are few places where you can see a great distance. Instance, the valley of the Thames, where could you see any object three or four miles away, let alone forty? The difficulty is at once brought home to any one who practically attempts to use this instrument; and even in India the solar haze is so great and so dense in the middle of the day, that the flash is completely obscured at long distances, unless sent from very high ground. This "solar haze" is such a practical difficulty in the use of either the heliostat or the heliograph, that it becomes another reason why this instrument could not be universally trusted. The particular instrument before us, has, in my opinion, and in the opinion of many who have adopted this system of signalling, been far surpassed by an invention of Captain Begbie of the Madras Engineers. He and I, and others who have used the instrument as at present presented to you, have noticed that the action of the thumb on the lever, has a tendency to alter the position of the glass. You must remember your tripod is standing probably on sand or gravel, and the constant pressure of the thumb would cause the mirror to slightly move; thus creating the long and short flash, has a tendency to alter the position of the whole instrument. This is another fatal objection to the instrument as at present represented. Another is, that the staff on which you take your aim at the distant station, is so slender, that in practice it is difficult to detect the flash on it. Captain Begbie's system has a circular rim of metal with cross wires from it, and where the wires intersect each other in the centre of this circle there is a small hole, through which you accurately sight the distant station. This can be done with such extraordinary precision, that you can have no sort of doubt about the distant station seeing your flash, if you can see it clearly. He then places a screen on a separate tripod, immediately in front of the mirror. By a pressure of the thumb the screen is raised or depressed, and the screen rising in front of the mirror, completely obscures the flash, without in any way moving the tripod on which the mirror rests; therefore, you may be perfectly certain, if your mirror is adjusted,

that your distant station can see it, and that the pressure of your thumb has not altered the direction. Another great thing against this invention is, that the earth is constantly moving, and the readjustment is most vexatious; you have to be constantly readjusting the mirror as the earth revolves. Therefore, unless you are prepared, without the slightest danger of losing your position, to gradually correct the angle at which the sun-mirror is, you are certain soon to find your distant station giving the vexatious reply "repeat," which means that they have missed your signal. Another objection is, that if the sun is rising and you wish to signal to the west, you are quite unable to do so. Captain Begbie has met this by a most admirable plan, which, once used, is found to be invaluable. He has two mirrors; if the sun is rising, he places one to meet it, and throws the light from that one on to the signalling mirror, and by that he gets the full rays of the sun's surface. One other thing deserves attention with regard to this subject, and that is, artificial light; that, I believe to be the coming agent to supersede telegraphs and everything else for short distances.[1] With a strong powerful lamp used, not exactly as this instrument is used, but simply put in a conspicuous position, screened in a way that the enemy cannot see it, laterally, or from below, you can then signal with the greatest ease, without any fear of detection and for the whole night, without a single readjustment. You place a lamp, we will say, on a table; you are in an upper storey and place your table so far back that you are sure the rays of light will not reach the ground near you, but they go straight forward to the distant station. You place a screen in front of the lamp, which is worked by your thumb. In that way you can sit through the whole night, or as long as your lamp is burning; it can be seen, probably, ten miles; a good, ordinary, powerful, Kerosene lamp can be seen for ten miles. I have signalled myself with a little 2½ lb. lantern for three miles with the greatest ease and without the use of glasses, with a powerful lamp I believe ten miles could easily be done, and that is really almost as much as is practically required. With lamps nothing can interrupt you, no clouds can come in the way. Very few nights in India are there any fogs, the fogs usually come on towards the morning, but at any rate, whether cloudy or clear, you can use a lamp. I have known times in India, when we have been for three weeks or a month without a single day in which it is worth while to send out parties five or six miles, for the purpose of trying the heliostat, because we are almost sure we should be interrupted by clouds, and that is a very great drawback. By the use of the lamp at night, a party having been engaged as an outpost party all day (from an Army advancing in the field) and having individually collected important information, can assemble together, and from the highest available point, can pass back to head-quarters the information so collected. This may be done by a lamp, the best lamp in the village; they need not always carry one with them, but the best lamp in the village put on a common table with a screen in front of it, will ensure their signalling back ten miles with the greatest ease and with no fear of interruption. A single cloud over the sun will interrupt communication by means of the heliograph, and the worst of it is, if it is too much relied on, you are not prepared with anything to take its place: therefore, the interests of the Army may suffer seriously in the field.

Mr. Goode: I am very glad to have found so able a coadjutor in the gentleman who has just sat down, inasmuch as many of the points to which he has referred will be found in the paper, but I omitted them in reading, on account of the lateness of the hour.[2] With regard to Captain Begbie's modification of

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[1] I believe that the electric telegraph is the only safe way of signalling a long distance, and is essential to the safety of an Army in the field.

[2] Another paper had been read earlier in the evening, the discussion of which occupied more than the allotted time, I therefore asked and obtained permission of the Chairman to omit certain portions of my paper which, if they had been read, would have anticipated many of Colonel Wilkinson's criticisms.

I may now be permitted to remark, that however liable to interruption heliograph signalling may be, the fact of communication being made possible at all, where the electric telegraph and all other signalling means have failed, is a fact of great

Mr. Mance's instrument (I think I am right in so describing it, and in claiming for Mr. Mance the credit of being the originator of the first practical means of talking by sun flashing), I may say, that Mr. Mance being in India when this idea was first worked out by him, he unreservedly put the apparatus into the possession of the Government of India, by whom it was tried under various phases and circumstances. As a matter of course, it got into the hands of the different signalling officers, and I presume of Captain Begbie amongst the number, who would naturally examine all the details of its construction, and doubtlessly endeavour to improve them. The instrument is not expected to be absolutely perfect, and it is quite possible that Captain Begbie's modifications may be of advantage. Mr. Mance's idea has been to keep the apparatus as simple as possible, and to confine it under ordinary circumstances to one instrument. This instrument weighs 5 lbs. with cases complete, and it can be made as light as 4 lbs. Captain Begbie's weighs 12 lbs., and being in two distinct parts, requires two operators. As regards the adaptation of artificial light to the heliograph, there is no doubt that the utility of the instrument can be vastly increased by that means, but the time at my disposal would scarcely admit of my entering into it fully, involving, as it does, the relative power of different lights, and many details as to the best means of preserving the signals from undesired observation. I have, however, mentioned that Captain Drummond's lamp was used for 66 miles in Ireland. For my own part I find a magnesium light, or a simple lime light, most convenient and serviceable, but an electric light at permanent stations might be more effective. The form of instrument to which I have chiefly directed your attention, is intended for use in the field, where the application of artificial light is not easy of accomplishment; with the other instrument here before you, which is constructed for permanent and semi-permanent positions, nothing could be simpler. With regard to the defects of sun-flashing, they are entered into to some extent in this paper. The heliograph is not put forward as an altogether independent means of signalling, but as an auxiliary. If the troops were operating in a country, where, owing to the formation of the ground, or want of sun, it was not available, they would simply fall back upon whatever signalling means they have at present. The instrument is made so light, portable, and inexpensive, that even if opportunity did not occur for its use, but little labour would have been wasted, while if its extraordinary power should be called into requisition, the results would fully compensate the trouble of carrying it.

With respect to the solar haze, the Indian reports speak specially as to the

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importance, although the capability may not be constant. Colonel Wilkinson's remarks bear almost exclusively on the use of the instrument in the field. The signalling authorities at home and in India concur, however, in the opinion that the chief value of the heliograph will be at permanent stations. When so used, a basis other than "sand or gravel" will of course be made for it, and the line of direction between the stations being once accurately ascertained and marked, would always remain the same, the instruments being fixed. Supposing, then, Mance's Heliograph to be when in the field defective in the points named, which in the face of the official reports and continued trials I cannot admit, in permanent positions these defects could not possibly exist.

As to the necessity of adjusting the mirror to the constantly changing position of the sun, that process is as incumbent on Captain Begbie as on Mr. Mance; if he did not observe it his apparatus would be of but little worth.

Colonel Wilkinson forgets to mention that the working of a screen through 90° to cut off the flash is a much slower process than altering the inclination of a mirror, say 2°, and also that two men are essential to the working of Captain Begbie's method, while one only is required by Mance's. The working expenses of the former at fixed stations are thus doubled, and the rate of transmission is much slower.

It has been fully acknowledged by the Government of India that Mr. Mance is the originator of the means by which talking by sun-flashing is accomplished, and if the little defects mentioned have been discovered in his apparatus they admit of a very simple remedy. Instead of applying it, advantage has been taken to associate another name with the system, and so to transfer from Mr. Mance the credit which I think all must admit to be due to the inventor of the heliograph.—S. G.

capability of the flashes to pierce any ordinary haze, up to 15 miles, in which respect it much excels any other visual signalling apparatus.

The difficulty of flashing due north, when the sun is due south, is apparent only. Mr. Mance in his *original* instructions, dated 1871, makes special mention of the use of a second mirror under such circumstances, which instrument would also serve as a reserve in case of accident.

It has been said there is some difficulty in getting the adjustment perfect, owing to the apparent movement of the sun. I can only say, that I find in the memorandum from the Quarter-Master General's Department, this testimony, "All the reports agree in the following points (*a*), that the signals given by the "heliograph are perfectly clear and satisfactory, and (*b*), that they can easily be "read in ordinary weather without telescopes up to 50 miles." And it is singular that the official reports should have been so unanimous in pronouncing the signals "clear and satisfactory," if they could not be directed truly, as in that case they would not be seen. It is quite possible that with instruments made in India without Mr. Mance's supervision, and with manipulators not very experienced in their use, some such difficulty might arise. But if the alignment is once correctly made, the signaller has only to see that the flash rises to the stud, and if so it must be visible. A slight movement of the adjusting screws obviates the movement of the sun, and this can be done without interruption to the signalling. I cannot assert that Captain Begbie's modification is attended with no advantages over Mr. Mance's method, but it is evident there are disadvantages too. I think you will see that it is simply a modification of it, and that to Mr. Mance is due the credit of having first utilized sun-flashing as a speaking means.

The CHAIRMAN: We must feel very much indebted to Mr. Goode for bringing this subject before us. The subject is certainly very interesting. As to the originating the plan of talking by reflections, I think we have had one instance of its being very old. I happen to know another, the case of Admiral Sheriff, then Captain of the Port of Gibraltar; and in 1835, he told me he used, with a common looking glass, to talk to his friends at Tangier continually. But these are all tentative things; after all the credit is due, not so much for digging the rude ore of any invention, but for perfecting it and bringing it to use practically for the nation. Though this instrument may not be perfect for close use in the field, I quite see that for distant use under certain circumstances, it may be of the very greatest importance, not perhaps as fulfilling all the communications requisite, between armies and distant stations, but as fulfilling a great many requirements of very great utility. At any rate, I think we are all very much obliged to Mr. Goode for having brought this before us.

APPENDIX.

THE MORSE CODE.

Having found the following table of great assistance in acquiring the Morse Code myself, and as I have known others master it by this means in a few hours, learners, who have no special arrangement of their own, may be pleased to avail themselves of it.

1. The signs or characters employed are two, ▬ the dot, and ▬▬ the dash.

2. The combination of these signs to represent the letters of the alphabet are arranged in two columns; all those commencing with the dot being placed in one, and those commencing with the dash in the other. No letter involves more than four signs.

3. In the dot column, the dot is regarded as the key-note. Recourse is not had to two key-notes until the various forms of one have been exhausted. Every succeeding combination is thus a wider departure from the simplest form than the one preceding it, and its position in the code is thus indicated.

4. The combinations are divided into three groups. In group 1 are placed all those in which *one* character only is employed; in group 2 the *second* character is *added*; in group 3 the *two* characters are *intermingled*. On the dot side of group 1

are the combinations, one dot, two dots, three dots, four dots, representing e, i, s, h, or the two-syllabled word e-ish; thè corresponding combinations on the dash side indicate t, m, o, not *t-o-m*, and ch, which is an extra.

In group 2 the order of the combinations is equally natural, one dot and one dash, one dot and two dashes, and one dot and three dashes, representing a, w, j; the corresponding combinations on the dash side are for n, d, b. The same group includes,—though somewhat removed, as having more than one key-note, u and v, represented by two dots and one dash, and three dots and one dash. On the other side two dashes and one dot are the symbols for g.

The combinations in group 3 in which the characters are *intermingled* all involve *four* signs; they represent l, p, f, on the dot side, and y, c, x, q, z, on the dash side, the order of which may be remembered by the phrase, "why see excusèd."
y c x q z

It will be seen that these follow the same rule as the previous groups; first, there is one dot and one dash (the number of signs in this and the remaining combinations of the group being made up to four by adding the sign of the column); then one dot and two dashes; then two dots and one dash, where the series stops. On the other side the order is one dash and one dot; then one dash and one dot with a different termination; then one dash and two dots, two dashes and one dot, and two dashes and two dots.

The two combinations at the foot r, and the counterpart k, are so placed because they involve *three intermingled* signs only.

Group 1.

e	·	*t*	—
i	· ·	*m*	— —
s	· · ·	*o*	— — —
h	· · · ·	*ch*	— — — —

Group 2.

a	· —	*n*	— ·
w	· — —	*d*	— · ·
j	· — — —	*b*	— · · ·
u	· · —	*g*	— — ·
v	· · · —		

Group 3.

l	· — · ·	*y*	— · — —
p	· — — ·	*c*	— · — ·
f	· · — ·	*x*	— · · —
		q	— — · —
		z	— — · ·
r	· — ·	*k*	— · —

The table is of greater service to a reader than to a sender, forming as it does a mental pictorial dictionary, to which any signal can be at once referred for interpretation. The first sign observed determines the column in which the combination is to be found; the right group is discovered in most cases ere the combination is completed, while its exact position in the group cannot be mistaken if the principle on which the table is arranged be once understood.

5, Gray's-inn Square, W.C. S. GOODE.

SPECIAL LECTURE.

Friday, June 18th, 1875.

General Sir WILLIAM J. CODRINGTON, G.C.B., Vice-President, in the Chair.

THE ARMED STRENGTH OF EUROPE.

By C. E. Howard Vincent, Esq., F.R.G.S., late 23rd Royal Welsh Fusiliers.

Two years, Sir William Codrington, have gone by since you were last pleased to encourage me by taking that chair. On the morrow of the day that I was afforded the privilege of occupying this place, I enlisted in the ranks of the law. The act was not unaccompanied by regret on my part, but chiefly on account of the severance which I feared to my connection with this Institution. The Fates, however, have been kind, and the Council yet kinder. At their request do I stand here to-day to address you, gentlemen, on the subject of "The Armed Strength of Europe."

The subject is, I fear, a dry one. It embraces many dull statistics. Nor in many of its particulars does it afford much scope for novel treatment. Yet its importance in the present era of "wars and "rumours of wars" is very considerable. To the task, unless, supported by your kind indulgence, do I feel myself wholly unequal. Other claims also have I on your lenient consideration—the necessity for passing the now obligatory legal examinations, a press of occupation, and last, but not least, the mass of conflicting data[1] with which I have had to deal.

[1] Works consulted *inter alia* :—

"Armed Strength of Russia." " " Austria." " " Denmark." " " Sweden and Norway."	Published by the Intelligence Department, War Office.
"Vergleichende Darstellung der Wehrverhältnisse in Europa zur Land und zur Sea."	Published by the Austrian War Office.

"Bulletins de la Reunion des Officiers."
"Revues Maritimes et Coloniales."
"Almanach de Gotha, 1875."
"Russia's Advance Eastward." (King and Co.)
"Statesman's Year Book, 1875."
"Vienni Sborniki."
"Rivista Militare."
"Jahrbüche fur die Deutsche Armée und Marine."
"Treaties of Guarantee." (Presented to Parliament.)

No doubt you have been struck by the peculiar fitness of the day for such a subject. At this very hour sixty years ago the fate of Europe was at stake. The field of Waterloo, now a peaceful plain, now the subject of a beautiful model within these walls, was strewn with the dead and dying. Backwards and forwards rolled the tide of battle; but ere sunset, British valour, timely succoured by Prussian bayonets, overthrew the foe to peace.

> "This England never did, nor never shall,
> Lie at the proud foot of a conqueror."

I must not detain you with the memories of a glorious past. I will hurry on to my subject. But how shall I treat it? Herein lies no small difficulty. Some have said, "take the major States separately, and group the minor;" some that I should consider Europe collectively. I shall, however, make bold to conduct you personally, as it were, round Europe. I shall pursue this course because I cannot help thinking that although a dwarf's cabin may lie at the castle gate of the giant, his action in certain contingencies may be of material importance to the great man. Again, the armed strength of nations is only of practical moment when relatively considered between possible foes, and neighbours must, *ex necessitate rei*, always be possible foes. Save as a matter of statistical interest, the aggregate contribution of European countries to purposes of war can only affect in a very remote degree the welfare of any individual State.

I have one other difficulty to lay before you—the express request that I should give due prominence to naval matters, but I regret to say that my knowledge of navies, of ships, is very limited.

Finally, I will remind you that, by the rules of this Institution, lecturers alone are responsible for what they utter in this theatre, therefore all my conclusions are purely personal, and in no way ratified by the Council or by any official.

Holland.

The route to Rotterdam is that offering the majority of advantages in commencing this continental tour. It lands us at once in a country whose welfare is of the utmost moment to ourselves. The supposed eyesore of a mighty neighbour—the independence of the Netherlands—is a matter of international concern. To preserve it, the House of Orange has an army supplied partly by voluntary enlistment, partly by conscription. Five years is the nominal period of service; but after one year, the recruits are allowed to return home, subject only to an annual training of six weeks, for the remaining four years. There may be some present who herein will recognise an idea that has been of late put forward for the instruction of our Militia.

In Reserves Holland is rich, or, rather, in poorly-trained adjuncts to the regular forces—a more than questionable support in the hour of danger. The Militia is divided into two classes, the first numbering some 40,000, comprising all men from the 25th to the 34th year of their age, and divided into groups, one containing the bachelors and

widowers without children, and the other married men and widowers with children. In addition to this active Militia, there is the "resting Militia," numbering some 71,000 men.

The military forces which Holland can assemble for the defence of the country consist, then, of—

68 battalions of infantry, of 5 companies,
111 companies of technical troops.
24 squadrons of cavalry, 4 to a regiment,
18 batteries of artillery of six guns,
with a "combatant" strength of
90,260 infantry, armed with the Snider and Beaumont breech-loaders,
3,850 cavalry,
108 bronze breech-loading rifled guns.

The Dutch navy consists of 113 ships (of which 17 are armour-plated), with 981 guns, and 7,250 men.

The navy is exclusively recruited by enlistment; for although conscription is allowable, it is never enforced.

Such are the artificial safeguards of Holland: and theoretically they are more than supported by the power of inundation. I take this latter, however, to be a remedy which would never be resorted to, for it must inevitably bring far greater suffering on the attacked than on the attackers. It is possible that an attempt at inundation might be made in an extreme case, the invaders giving timely notice of their approach, so as to enable the Dutch to remove themselves, their homes, and their goods to secure havens; but I feel convinced that any rapid invading movement would materially bring out the philosophy of the Dutch character. We must take steps to frustrate the ingress of the thief, not content ourselves with the reflection that if he does effect an entrance we shall set fire to our house. "Forewarned is forearmed." It is useless for threatened States to stem the tide, the bitter stream, of universal service. The Dutch must sacrifice some comfort that they may be shielded against the coming storm.

Belgium.

We next come to Belgium—to a land dearly allied to us by dynastic ties, by uniformity of interest and by solemn treaty. Here, too, we find a country threatened, continually threatened, not by one gigantic neighbour, but by two. In the same degree that Germany looks paternally over Holland from the community of language, does France look with maternal affection over Belgium. How often even within my own time has the safety of Belgium been, or imagined to have been, endangered? Nevertheless, here, as in the sister country, do we find an army formed by conscription, with substitutes. The period of service is eight years, two-thirds of which are usually spent on furlough. In addition to this active Army there is a *Garde Nationale*, comprising every Belgian capable of bearing arms, but neither fitted nor intended for service in the field. Numerically the *National Guard*

is strong enough, 125,000, without the reserve, or 400,000 with it. In Belgium, then, we find—

84 battalions (mostly of 4 companies) of infantry, armed with Albini, Braendlin, and Comblain breechloaders;
16 companies of engineers;
45 squadrons (4 to a regiment) of cavalry;
20 batteries (of six guns) of artillery;

with a "combatant" total of 130,000 infantry, 7,500 cavalry, and 152 guns, on the Prussian system.

Since October, 1874, the kingdom has been divided into two military conscriptions, the one embracing the provinces of Antwerp and of East and West Flanders, the other Brabant, Hainaut, Liège, Limbourg, Luxembourg, and Namur.

Do you tell me that I ignore the first requisites of national prosperity when I say that compulsory and universal service is necessary for two thriving and industrial peoples? I am sensible of the reproach. I am sensible of the misery that such an innovation must necessarily entail. I am aware of its results in a neighbouring country. But the very existence of Holland and of Belgium as independent States hangs on their being able at any minute to act up to that sovereign rule of war, "to bring masses to bear on fractions of "the enemy." No "silver streak" has to be crossed by an invader. No time will be given for preparation, for mobilisation. Six hours after the declaration of war, hostile troops will be within the frontier, and, as the *Fortnightly Reviewist* aptly remarks, "The Belgian Army "is not fit—and no one knows this better than the Belgian Ministry "—to be put into line of battle."

The reflection is melancholy for ourselves, for our ally, and for the peace of Europe, as Great Britain, conjointly with France, Prussia, Russia, and the Netherlands, is bound by treaty, concluded in 1839, to preserve the independence and neutrality of Belgium, and by treaties with Germany and with France in 1870, to co-operate for that purpose with her naval and military forces against the invader. I have little doubt that our assistance skilfully rendered would effect the desired end, yet it is not too much to require of Belgium that she should be prepared to help herself.

Sweden and Norway.

But let us turn to a brighter picture. Let us follow that brilliant example of British enterprise, the Arctic Expedition, on its northern course. Yet not into the frigid zone that is to witness its labours. We will alight rather in that happiest of kingdoms, Sweden and Norway. Safe from invasion, devoid of ambition, thrifty, contented, and industrious, at peace within, at peace without, free from sorrow in the present, secured from danger in the future, Oscar II sways a sceptre worthy of his race.

The organisation of the Army is peculiar, nor does it appear to me based upon any sound and modern principle. Four times did the late King submit measures to the representatives of the people, for the

reorganisation of the defences of the country, and four times did the deputies elect to pursue the even tenor of their way.

In Sweden we find four distinct classes of troops—

(1.) The "Värfvade" or enlisted troops, including two regiments of cavalry, the artillery, and the engineers, the whole numbering 6,718 Officers, Non-commissioned Officers, and men.

(2.) The "Indelta" or national Militia, maintained by the landowners and out of the proceeds of certain state domains. For this expenditure the landlord is exempted from further contribution to the peace establishment. Service in the Indelta is determined by the ordinary law of master and servant. The landowner makes a bargain with his servant, secures to him certain payments and advantages, and the contract is upheld by the State. The length of service extends over thirty years. In time of peace the infantry are called up for one month's annual training and the cavalry for 42 days.

(3.) The third class consists of the Militia of Gothland.

(4.) The fourth of the "Beväring" or troops levied by conscription without substitutes, between 20 and 25 years of age. The "Beväring" is divided into five classes, the two youngest of which alone are liable to be called out for yearly exercise, and that for only 15 days. It is supposed that the "Beväring" might produce some 92,000 in all, but the calculation is far from easy.

I cannot hope, in the limited time at my command, to convey to you any accurate idea of the complicated military system of Sweden.

In Norway we find a far more tangible machinery. The Army is supplied partly by conscription, partly by enlistment, and is supplemented by the Landvaern or Militia—liable only to serve within the kingdom—and then again we have the Landstorm.

In all, the military forces at the joint disposal of Sweden and Norway, may be said to amount in time of war to—

122 battalions, mostly armed with the Remington,
15 companies of engineers,
58 squadrons of cavalry,
40 batteries of artillery,

with 152,800 infantry, 10,540 cavalry, and 322 guns, plus 20,000 Volunteers.

The Navies of Sweden and Norway are both recruited partly by voluntary enlistment, partly by conscription among the seafaring population.

United they consist of 65 vessels, of which 5 are armour-plated, with 491 guns, and 5,100 men.

Sweden and Norway, by Treaty concluded in 1855, we are also bound jointly with France to protect against any Russian attack that may be directed against them. The advantage—the maritime advantage—of the kingdom to Russia, is undoubtedly great; but although at one time the eyes of the St. Petersburg Cabinet were directed in that quarter, we may rest assured that there is no danger at present of our being called upon to fulfil our obligations; and even should such arise, despite the probable attitude of France, we need have little fear for the result.

Denmark.

Denmark is the next country which invites our attention. A Princess of its Royal House, now on the steps of the British Throne, commands for her country the unbounded affection of Englishmen. Valiantly as strove the Danes through the bitter winter of 1864, "God favoured the big battalions," and the reckoning for Denmark has yet to come.

Her troops are of the best quality, of the best *physique*, yet perfect organisation still is wanting. A new scheme has recently been presented to the Danish Parliament, and will no doubt be adopted in its principal provisions. Several years must nevertheless elapse ere it can be regarded as an accomplished fact.

Denmark is wiser in its generation than the three minor powers we have just considered. In 1867, compulsory service was established for all able-bodied males between the ages of 22 and 38 years—16 years in all, whereof 8 are passed in the regular Army, and 8 in the Reserve. Of the first portion the men are under arms but a limited time; they are then released on furlough.

The combatant strength of the Danish Army may be set down, as far as I am able to gather, at—

5 Territorial brigades,
42 battalions of infantry, armed with the Snider and Remington rifles,
28 companies of engineers,
21 squadrons of cavalry,
12 batteries of artillery,

with 36,050 foot, 2,100 horse, and 96 guns.

In given contingencies, the action of the Danish fleet may be of the utmost importance to Great Britain. It is small numerically, but acting in a confined area, wherein possession is more than nine points of the law, its efficient condition is a matter of no ordinary moment.

The navy of Denmark is recruited by conscription from the seafaring population. It comprises 31 steamers, whereof 6 are ironclad. Three have been converted on the French model. The strongest vessel is the "Odin," of Danish build, a turret 8-inch armour-plated screw vessel, fitted with a peculiar steel ram, 6 feet in length, and hidden, when not required, in the hull. The "Odin" carries four 10-inch 19 ton guns.

I cannot dismiss Denmark from your consideration without calling to notice the very important project for defence embodied in the novel scheme. It includes—

(1.) The establishment of works on the Little Belt.
(2.) Establishment of works on the Great Belt.
(3.) Establishment of a coast battery at Kronborg.
(4.) Strengthening of the sea works at Copenhagen.
(5.) Strengthening of the land works at Copenhagen.
(6.) Augmentation of the Fleet.
(7.) Establishment of a *point d'appui* for the Fleet on the Great Belt.

Look at the map behind me, and observe for yourselves what will be the possible effect of these plans. Look at the narrow passage any westward bound fleet has to pass through, and tell me if I over-estimate the importance of the Danish hold of the Belts and the Sound. As we hold the door to the Mediterranean, so in a measure does Denmark hold the passage of the Baltic. In four years the defences of the Great and Little Belt will be completed; in seven, those of Copenhagen. Let England hold out the hand of friendship. Let us secure an ally, and let the amity of Governments and the love of peoples cement the ties of Royal blood.

Germany.

To the old Prussia, now developed into the modern Germany, does Europe owe the startling military reforms of recent years. How different 61 years ago was the official tone of Berlin. Ministers came and went down to their bureaux oppressed by the falling fortunes of the State. The gardens were deserted. How to resist Cæsar was the waking and the sleeping thought of all grades.

But from out that Slough of Despond there came two masters. A mine is laid. The issue of this anniversary encourages the sinking of the shaft. Gallery after gallery is run out; flaws are remedied. Fifty-two years of practically uninterrupted quiet favour the perfecting of the fabric, and then as with a spring the roof is removed. The country's rival bites the dust, and Europe stands mute with mingled fear and admiration.

You cannot wish me to enter into any detailed consideration of the marvellous process by which Teuton masses bear down upon their enemy. More than once has this theatre been a witness of the admiration in which you hold it. For years the public journals have teemed with descriptions, with panegyric now of this branch, now of that. I will therefore content myself with observing that the German Army numbers in time of peace—

18,079 Officers,
401,659 men,
97,379 horses,

which are in time of war increased to—

31,195 Officers,
1,273,346 men,
270,920 horses, and
2,472 field guns.

In addition to these gigantic totals, the new Landsturm Bill provides an organised force for the defence of German hearths and homes. The Landsturm is to be divided into two classes. The first, including all able-bodied men not already in the army, distributed into 293 battalions, and calculated to produce 175,800 men.

This addition will bring the German war strength to over 1,700,000 men!

The second base of the Landsturm will include every other available male, but will not for the present be organised.

One million and three-quarters of men available! One million of combatants, whereof half can be brought to-morrow to bear on any one spot!

But think not that this result is achieved without effort. Consider that it demands the greatest sacrifices from every class of society. The nobility tread for life in the unremunerative profession of arms. An axe is held over every united family, every domestic circle. The "emigration returns" show how great is the burden. A veritable exodus has taken place since the war, and I am informed (though with what truth I cannot say), that a treaty on this head is in negotiation between Germany and the country where these tens of thousands of fugitives from the yoke of military service find a ready shelter and the road to wealth.

The German Navy is yet in its childhood. But a very short time ago it was in its infancy. Now it is rapidly growing into manhood. In 1848 only was the foundation laid. For the last few years no efforts have been spared to hasten its development.

The two largest ships are the ironclads "Kaiser" and "Deutschland," both built by Messrs. Samuda Brothers at Poplar, after the designs of Mr. E. J. Reed, C.B., and both armed with eight 22-ton steel breech-loading guns, arranged to fire broadside. The two foremost guns, one on each side, are also adapted for use as bow-chasers, and are capable of being trained to cross-fire before the ship. The two after guns can be trained to fire within 15° of the line of keel. In addition to these eight guns there is an 18-ton gun placed aft capable of being trained to an angle of 15° each side the middle line, thus making, with the central battery guns, a complete all-round fire.

The four next ironclads of Germany are the turret ships "Grosser Kurfürst," "Friedrich der Grosse," and "Preussen," all the production in 1873 and 1874 of German dockyards.

The navy is manned by some 9,000 Officers and men; the latter drawn by conscription from the seafaring population, estimated at 80,000, who on that account are exempted from military service.

Great inducements are further held out to able-bodied seamen to volunteer for the navy, and not a few are thus obtained.

Germany has three ports of war, at Kiel and Danzic, on the Baltic, and at Wilhelmshaven, on the North Sea. The latter is the most important, and is intended for the nursery of the German Navy of the future.

The port of Wilhelmshaven is an immense artificial construction of granite, comprising five separate harbours, with canals, sluices to regulate the tide, and an array of dry docks for ordinary and ironclad vessels. The first harbour is an artificial basin 700 feet long and 350 wide, leading to the first sluice, 132 feet long and 66 wide. The next basin or outer harbour is 600 feet long and 400 wide, with a similar sluice behind. Then comes a canal 3,600 feet long, varying in width from 260 to 108 feet, and having about half-way another harbour for dredging steamers and similar craft. This leads to the principal basin, 1,200 feet long and 750 wide, having a small adjacent basin for boats. At the back of the principal harbour are two large shipyards.

Such is the state of the German Navy, and such the means of development that it actually possesses. Its ships are fine, its Officers well trained and bold, its men hardy as our own, but its growth must be limited until such time as its range is extended on the North Sea. Such time will come, must come, be it soon, be it late, and then must England look to her laurels.

Russia.

Eastwards will we now direct our steps—to that country whose every movement is eagerly watched by ourselves, by all Europe. Often before has the attitude of the Russian Court been the cause of much anxiety, but never was Russian influence more paramount in the counsels of European Cabinets. Sixty years ago such was the position of England, but "*tempora mutantur.*"

We will cross the Vistula at Warsaw. Two bridges will shortly carry the passenger over the stream. The one a railway bridge, either end protected by a fortification, which, in the event of invasion, will entirely supplant its stately fellow. We will not tarry in Poland. We will plunge at once into the heart of the empire.

"The Russian Army"[1] formed the subject of a lecture of mine in this theatre three years ago. Some of you may probably have read it. I need not therefore trouble you with any detailed account of Russian military organisation. I will simply say that the universal service on which it is now based produces a total war strength of

752,095 combatant infantry,
172,743 cavalry,
with
2,768 guns, including
400 mitrailleuses.

In ten or fifteen years, the land forces of the empire will number two million men, of which about three-fourths will be combatant.

Owing, however, to the vast area of Russian territory, the difficulties of communication, and the conditions of climate, this gigantic total is much less alarming than it at first sight appears.

The Russian Navy is increasing every day in importance, but owing to more than one geographical consideration, its sphere of action is at present very limited. Numerically the Russian Navy consists of some 300 vessels, including 25 ironclads, with an armament of over 1,500 guns. By far the most important part of the navy, and nearly all the ironclads, comprise the Baltic fleet. For eight months of the year it is doomed to a forced idleness, and at best has to pass treacherous channels ere the wide ocean places it on an equality with its rivals.

The other great division of the fleet is stationed in the Black Sea. It numbers some 35 or 40 vessels of light draught, carrying about 90 guns. To them a new circular ironclad of unusual power has recently been added, and the dockyard at Nicolaïeff has plenty of work on hand. Indeed this is no novelty, and the local authorities

[1] See Journal, vol. xvi, page 285, *et seq.*

were but little taken aback by the act which restored the Black Sea to the Russian flag of war. It is highly improbable, however, that the Government of the Tsar contemplate making any great additions at present to the Black Sea division, nor to form an ironclad fleet in those waters, and this for reasons that must be patent to every one.

The first vessel of the Russian ironclad navy, unless it be the new "Novgorod Popoffka," is the mastless turret-ship "Peter the Great," launched at Kronstadt in 1874. The "Peter the Great" resembles in design and construction the great mastless turret-ships of the British Navy, and more especially the "Devastation." The "Peter the Great" carries, like the "Devastation" and her sister ships the "Thunderer" and the "Fury," two turrets, with an armament of four 35-ton guns, the latter made of Krupp steel. After the "Peter the Great" rank the "Sevastopol," nearly on a par with the "Black Prince" and "Warrior," and then the "Kniaz Pojarski."

Turkey.

We have now arrived at the centre of the Anglo-Russian future—Constantinople. From here, and not from Asiatic steppes, radiate the troubles to come. Much could I say on this head, but this is neither the time nor the place. Suffer me though to entreat you not to be misled by movements and counter-movements far from the true arena of action. Search the fruitful plain below instead of straining your eyesight by peering into a desert horizon.

Since 1871 the Turkish Army has been completely re-organised, but whether co-equally in theory and in practice it is not for me, with such feeble resources as are at my command, to opine. Official statements set down the military forces of the Sultan last year as consisting of—

170,376 regulars,
148,680 reserves,
75,000 auxiliaries,
87,000 irregulars;

Presenting a grand total of—

353,551 combatant infantry,
21,275 cavalry,
with 648 guns.

The Turkish ironclad Navy is, I believe. one of the finest in the world, and is, as you doubtless know, commanded by an Englishman of no less ability than experience. Twenty splendid ships lie "at anchor," says a diplomatic report, "all the year round in idle state in sight of the Imperial Palace." Such a force, put to so little use, may well be looked on wistfully from other quarters.

You well know that, conjointly with Austria and France, we are bound to preserve the independence of the Ottoman Empire, and that independence, whether with but one ally, or alone, we shall, we must, and we can maintain.

I will not add more as to the condition of things in Turkey, espe-

cially as I hope to go this year and see what cannot be ascertained from books.

Greece.

We need not tarry long with the 100,000 Greeks and 50 guns, with the 20 ships and 2 ironclads that the Government of Athens is reputed to have at command; we will therefore, hurry northwards to

Austria—Hungary.

The Austrian army has likewise afforded me a previous theme in this theatre.[1] Immense have been the efforts of recent years to reduce to a minimum the possibility of such ill fortune attending the valour and the nobility, of the Hapsburg arms in the future as has beset them in the past.

798,172 infantry,
62,746 cavalry,
and 1,616 guns,

can Austria, our historical, our natural ally, now put into the field; and rapidly recovering from the disasters of a double war, guided by prudent statesmen, bordered by two puissant States, both courting her alliance, both dreading her enmity, the Viennese Government is every day producing a more direct influence on European affairs.

The Navy has not been thrown into the shade by the efforts that have been directed towards the Army. Eight or ten ironclads now form the fleet of Austria in the Adriatic. The most formidable vessel is the new "Custozza." The battle of Lissa fully demonstrated the utility of the ram, and this experience has been borne in mind in the construction of the "Custozza," though in such degree as to enable both the ram and the artillery of the ship to be employed simultaneously, a result unachieved, I understand, as a general rule.

Austria has two harbours of war—Pola and Trieste. The former has been recently enlarged, so as to be able to accommodate the entire fleet, and is strongly fortified both towards the sea and the land, while Trieste is the great arsenal of the Imperial Navy.

We will now pass to

Italy.

The Government of *Il re Galantuomo* has not been the most backward in responding to the call of the day in its military institutions. The German law of universal liability forms the basis of the present military organisation of the Kingdom of Italy. Some 70,000 young men are levied annually for the standing Army, while the rest are relegated to the Reserve, subject to an annual call for forty-two days' training.

By a recent enactment, the country was divided into sixteen territorial military districts, and according to official returns published last year, the combatant war strength of the Italian Army consisted of—

[1] See Journal, vol. xvii, page 527, *et seq.*

447,264 infantry, armed mostly with the Remington breech-loader,
15,850 cavalry,
and
1,240 guns.

Great attention has been paid to the requirements of modern science as regards the Italian Navy, and large contracts have recently been, or are about to be entered into. But, as in February last, the Government determined to sell 32 ships, I am wholly unable to set before you the numerical strength of the Italian fleet.

The Italians are building an immense dockyard and arsenal at Spezzia, which will doubtless be the great depôt. Venice, however, affords a secure base of operations in the Adriatic.

Spain.

From Italy we may glance at Spain, but of the military forces of that country, you, Gentlemen, are as competent judges as all the official documents in the world. The state of affairs is more than deplorable, and we can but hope that Cabrera's untiring efforts towards peace may ere long terminate the troubles of his youthful Sovereign.

Time was when the Spanish Navy knew but one superior. It still contains some 7 or 8 ironclad vessels, all built in England, with an aggregate armament of 169 guns. There are also, says the Austrian War Office, 67 other vessels, but it is difficult to conceive that the Army has not deprived them of their due complement of men.

Portugal.

Amid all the disturbance around, Portugal treads calmly on. Its Army, like those of the minor Northern States, is formed partly by conscription, partly by voluntary enlistment. Eleven years ago a project of reorganisation was adopted, but financial causes have intervened to check its development. Yet it is probable that with time to organise, and an incentive to energy, the Portuguese could put some

50,000 combatants and
100 guns

into the field.

The Navy of Portugal numbers about 50 ships, but not more than one-half are seaworthy. I am informed, however, on high authority, that 6 ironclads now building in England will shortly claim the Tagus as their home, to be joined, if the almost impossible necessity arise, by the fleets of Britain, in fulfilment of various treaties concluded between 1373 and 1815.

Switzerland.

Many of you, whilst delighting in the scenery, have probably made yourselves acquainted with the defensive system of Switzerland—that peculiar system, which a writer, more zealous than practical, thought well adapted for Great Britain.

You are aware that by the fundamental laws of the republic the maintenance of a standing Army is prohibited. The 18th article of the Constitution of last year enacts that "Every Swiss is liable to serve in the defence of his country." He may indeed serve, but how is he to get the training necessary to give effect to his service—by a fortnight's annual exercise?

The troops of the Republic are divided into three classes, viz.:—

(1.) The Bundes Auszug, consisting of all men able to bear arms from the age of 20 to 30.

(2.) The Reserve, consisting of all men who have served in the first class from 31 to 40.

(3.) The Militia, comprising all men from the 41st to the 44th year. The Officers themselves are not a permanent Institution.

The paper strength of this force is set down at 201,578 men, which is "estimated" to produce a combatant total of

174,000 infantry,
5,000 cavalry, and
294 guns.

Does history show that battles are won by patriotism alone? If so, the Swiss will overthrow any foe. If not, the pecuniary subsidies—men they cannot be—that England will have to furnish by the Treaty of Paris of 1815, will be thrown away.

France.

We are now nearing the end of our tour. France alone remains for consideration, that "nation of gallant men, of men of honour, and of "cavaliers." With a recuperative power peculiar to Gaul, Frenchmen have been unremittingly devoting themselves to remedy the evils in their military administration which the last war laid bare in so terrible a manner. Those, however, who know France best, who have resided there of late, will need no telling how much there is yet to do, in what a transition state is the whole mechanism of the Army, how wholly unfit it is at present for revenge. The new laws are but imperfectly understood by the local officials, and years must elapse ere the eagles of France can again be borne against a foe. Not half a million combatants is it possible for France to put into the field, and ere even this, we may almost say paltry, number could be brought to bear on any one spot, could be available for the defence of one frontier, could be concentrated for any attack, months of preparation would be essential.

Gentlemen, these are facts—facts, it may be, but little palatable to the pride of Frenchmen, but, nevertheless, undeniable facts, which you will do well to bear in mind when reflecting upon recent events.

It may none the less be interesting to you to know the rough outline in the French project of Army reorganisation. It is well embodied in the first article of the third chapter of the "Loi sur le Recrutement." "Every Frenchman not declared unfit for military service must be "for 5 years in the active Army, for 4 years in the Reserve of the "active Army, for 5 years in the Territorial Army, and for 6 years in

"the Reserve of the Territorial Army." Neither the active Army nor its Reserve are in any way localised, but drawn from and distributed over the whole of France. On the other hand, the Territorial Army and its Reserve are confined to determinate districts.

A very marked improvement has taken place since the war, in the officering and training of the French Army. Greater attention is paid than before to technical study and professional duties, and, learning from the victor, no pains are spared to develope the efficiency of the soldier.

The Navy is now much sought after by the blue blood of France. In ships it is strong. Hard upon 350 ships of war hoist the tri-colour. Some 50 vessels form its ironclad fleet, and although I am informed that their efficiency is great, it is somewhat to be feared that the demands on the public purse with respect to the Army will preclude for the present any considerable expenditure on vessels of the most recent and formidable type.

The French Navy is manned partly by conscription and partly by voluntary enlistment. So early as 1683 was the marine conscription introduced. On the *Inscription Maritime* are the names of all males of the maritime population, numbering some 150,000. The length of service in the Navy is similar to that in the Army, and the law of 1872 provides that a certain number of young men liable to service in the active Army may select instead the naval service, if duly fitted thereto, even if not enrolled on the *Inscription Maritime*.

For administrative purposes France is divided into five maritime districts, viz.:—

(1.) Cherbourg, (4.) Rochefort,
(2.) Brest, (5.) Toulon,
(3.) Lorient,

each presided over by a Vice-Admiral, bearing the title of *Préfet Maritime*.

Great Britain.

From Cherbourg we again take

"Our heritage, the sea,"

and return home. I will not occupy your time with our British Administration. It is known far better to you than to me. I have endeavoured to lay before you the naval and military strength of continental nations. You are all mentally comparing our position with theirs. Permit me briefly to aid you.

The inherent delight of Englishmen is to depreciate themselves, to condemn their own institutions. Nor is it an exercise, moderately indulged in, that can seriously mislead the earnest student of English character. Of late, however, the Army, and, in a minor degree, the Navy, have been the victims. It may be that the Services are in many points defective, but, nevertheless, half a million Britons are ready to die for their country. It is true that three-fifths of these are but moderately trained troops of reserve, that more than one-fifth are abroad; but it is a fact—a fact not communicated by any official, but

a fact ascertained by one, whose name, were I to mention it, would of itself import truth—that an army corps of 50,000 regular troops, complete in all its branches, could within a week set sail from our shores.

You are incredulous. You ask of what material the Army would be composed; to whom would the defence of the kingdom be left? Well, the Army would be composed of troops equal to any of the same number that could be brought against them. The other day, a distinguished Field Officer, formerly in the Guards, went to Aldershot full of conviction that we had no fighting men. He returned home at night, glad that he went to see for himself, and determined not again to give heed to alarmist cries. Last month, when at Aldershot, I made every effort to ascertain from regimental Officers, if they were in such despair about their men, about their recruits. In no single instance did I succeed. Why, then, is there this agitation against every detail of our administration. I will tell you, and not in my own words, but in those of a foreign Officer of no less experience than capability of observation:—

"Whenever anybody, any civilian, any officer, any private, sees, or "fancies he sees something which might be improved; whenever he is "aggrieved, or fancies himself aggrieved by any fundamental rule or "administrative order, he throws his complaint, often exaggerated, "often unfounded, into the columns of the Press. Questions are put in "the House of Commons, and others desirous of giving their grievances, "their suggestions, like notoriety follow in the same train. No foreign "Government could tolerate such a system. Think you that no auto-"cratic order ever emanates from the German War Office; that no "Prussian soldier unable to bear the weight of his pack faints on the "march; that no Russian is ever too severely punished; that no "Austrian ever receives a bad and tardy ration? Such things must "happen in the case of any large body of men, always have happened, "always will happen, but no editor at Berlin, Petersburg, or Vienna "would venture to comment on such ordinary occurrences. The "growing system of running down the Army on all occasions must "produce, aye, is producing, a most pernicious effect. Remember "what that keen observer Baron Stoffel wrote concerning the causes "of superiority in the Prussian service:—'Nothing is omitted which "'is calculated to give the Army confidence in itself, to cause it to "'be honoured, to surround it with every possible consideration. All "'favours are reserved for it, and everything tends to give it, in the "'eyes of the nation, and in public opinion, the character of a glorious "'institution.' Nor lay less to heart what H.R.H. the Duke of "Cambridge remarked the other day, a dictum which should be hung "up in every place of discussion, in every newspaper office within "the United Kingdom. 'If persons go on driving into the minds of "'the men that they are mere riff-raff, it tends to break the spirit of "'the Army, and the Officers are in danger of beginning to think so, "'too, and thus the whole organisation of the Army may be dete-"'riorated.'"

I said just now, that every available regular soldier might be sent

out of the kingdom. The Militia regiments, for the most part full of robust, developed men, for the most part of unprecedented efficiency, giving a force 150,000 strong, admirably officered, form a reliable second line—a second line which, with a little handling would, in the case of a popular war, be available for service in the field. This is no idle hearsay, and let me tell you, that there is a brigadier at Aldershot, a brigadier who has filled high places, who will, if occasion arise, hold high command, and who believes firmly in the efficiency of the Militia. Enforce the ballot, make the Militia liable to serve abroad in time of war, organise reserve field artillery and transport, give the recruits three months' additional training; let Government have a right to purchase at a fixed sum all untaxed horses, and a vast Army will always be ready to uphold the honour of England. The moment is opportune. Preparation and acute diplomacy must do the rest. Then will our influence return. Then there will come a period of unbroken peace.

Yet if we should be called upon to put forth our strength to aid our allies, to insist on quiet, the embodied Volunteers will defend our shores. Business, even then, would suffer far less than in the markets of armed nations. I cannot but believe that the reflections recently made in this theatre with respect to the Volunteers—the 150,000 who give, gratuitously give, time, trouble, and money, to acquiring such a military foundation as must, if ever seriously built upon, prove of immense value—were hastily conceived, and are wholly unsupported by the country.

The Volunteers of Great Britain, I submit,—backed as I am by more than one reliable authority,—are the finest body of men of their class in Europe, and far superior to any Garde Nationale on which, as we have seen, some nations stake their safety—an institution without its equal, without its parallel in history; and, looked upon alone as a recruiting field for the Army actively engaged, its value is inestimable, and the movement cannot be over-encouraged, over-fostered.

Now, Gentlemen, for the Navy—the Royal Navy of England, which in the well known words of Sir William Blackstone, "hath ever been "its greatest defence and ornament; its ancient and natural strength "—the floating bulwark of our island." Look at the figures in the accompanying table. As regards the British Navy, they are, I believe, correct, and they speak volumes for themselves.

THE NAVIES OF EUROPE.

Country.	Vessels afloat, including ironclads.	Vessels building, including ironclads.	Guns.	Men.
Austria	47	10	250	12,834
Denmark	31	1	291	3,700
England	586	29	6,250	60,000
France	336	35	1,666	29,851
Germany	60	10	542	9,528
Greece	20	none	210	1,076
Holland	113	none	981	7,250
Italy	74	3	610	22,000
Portugal	48	6	288	3,520
Russia	297	2	1,663	31,000
Spain	75	3	835	25,400
Sweden and Norway	65	5	491	5,100
Turkey	110	6	1,282	65,570

N.B.—The above data are only approximative.

Summary.

And now to summarise briefly the results of our observation.

Of the fifteen States of Europe, seven have introduced universal liability to military service—Germany, Russia, Austria, France, Italy, Denmark, and Switzerland. The armies of seven are recruited by conscription, or conscription and enlistment, viz., Spain, Turkey, Sweden and Norway, Holland, Belgium, Portugal, and Greece, while in England alone are we solely dependent on voluntary enlistment.

Looking at the armies of Europe from every point of view, the rapidity with which they can be mobilised; fed from reserves concentrated on any point, and maintained in the field, they may be ranged in the following precedence:—

1st Class.
(1.) Germany.
(2.) Austria.
(3.) Russia.
(4.) France.

2nd Class.
(5.) Italy.
(6.) England.

3rd Class.
(7.) Belgium
(8.) Turkey.

3rd Class.
(9.) Sweden and Norway.
(10.) Holland.
(11.) Denmark.
(12.) Spain.
(13.) Portugal.
(14.) Switzerland.
(15.) Greece.

Altogether four armies of the first class, two armies of the second, and nine armies of the third, with, in round numbers, a paper strength of seven and a half millions, and a combatant strength of five millions, with 15,000 guns, and a million and a quarter of horses.

In navies Great Britain is supreme; then come in their order, France, Russia, Turkey, Austria, Germany, Italy, Spain, Holland, Denmark, Sweden and Norway, and Portugal, with an aggregate total of 2,039 vessels, of which 209 are ironclad, the whole being manned by

some 280,000 men, and armed with 15,000 cannon. 110 ships of are building in European dockyards, and of these 56 will be arm plated.

The expenses incidental to the Armies and Navies of Europe ex 112 millions sterling per annum, of which fully three-fifths are dev to the land forces.

Turkey and Austria keep their troops at the least cost, viz., at ab £29 a year per man; the maintenance of the British soldier is dearest, close upon £100 per annum. But then he is of the bravest the best, so Gentlemen, with much gratitude for the courteous hear you have given me, in taking leave of you, Sir William, and of " Armed Strength of Europe," do I say that I am thankful to belo in however humble a sphere, to

> " This fortress, built by Nature for herself
> Against infection, and the hand of war;
> This happy breed of men, this little world;
> This precious stone set in the silver sea,
> Which serves it in the office of a wall,
> Or as a moat, defensive to a house,
> Against the envy of less happy lands,
> This blessed plot, this earth, this realm, this England."

Appendix.

THE ARMIES OF EUROPE.

Country.	Combatant.			
	Infantry.	Cavalry.	Guns.	Horses
Austria	798,172	62,746	1,616	172,98
Belgium	130,000	7,500	152	13,80
Denmark	36,050	2,100	96	9,80
England	359,650	29,081	1,402	70,00
France	463,690	45,886	1,796	161,91
Germany	984,281	94,674	2,472	270,92
Greece	100,000	450	50	2,16
Holland	90,260	3,850	108	10,00
Italy	447,264	15,850	1,240	82,15
Portugal	58,000	5,300	116	7,50
Russia	752,095	172,743	2,768 including 400 mitrailleuses.	348,101
Spain	152,000	13,000	228 including 30 mitrailleuses.	30,00
Sweden and Norway	152,800	10,540	322	20,700
Switzerland	174,065	4,564	294	—
Turkey	353,551	21,275	648	59,945

N.B.—The above data are only approximative.

LECTURE.

Wednesday, June 23, 1875.

General Sir WILLIAM J. CODRINGTON, G.C.B., Colonel Coldstream Guards, in the Chair.

THE COMPANY AS A MILITARY BODY.—ITS ESTABLISHMENT.—THE BEST NUMBER OF COMPANIES IN THE BATTALION.

By Colonel Sir Lumley Graham, Bart.

Indifferent as the British people has generally shewn itself to matters concerning the organization of armies, there are two great military questions which have of late years occupied a large share of public attention, having been much discussed in Parliament, and in the newspapers, besides furnishing a theme for many pamphlets and essays.

I refer, firstly, to the question of appointment, promotion, and retirement of officers; secondly, to that of recruiting and reserves.

These two subjects belong to a class of universal interest, involving, as they do, not only military but also political and social considerations, and containing within themselves problems, upon the right solution of which depends the very existence of the army and of the empire.

The question upon which I have the honour of addressing you now is neither of such vital importance, nor of such general interest. It is purely and simply a military question about which few civilians will trouble their heads. Still, for us soldiers it is, I believe, a most important question, and one which has not been sufficiently studied in this country, even by the profession.

Great Britain is *par excellence* the country of companies in a non-military sense, but I do not think that the company, as a military body has ever been held in proper estimation amongst us; moreover, I think that of late years, owing to various causes which I shall notice further on, it has been declining in importance, whilst in foreign armies it has, in obedience to what I conceive to be sounder military principles, been steadily rising in value. Holding these

views, I believe the present state of things to be detrimental to the efficiency of our Army, and especially of our infantry, and I have sought an opportunity for advocating the cause of the company, for promoting a full discussion of the subject by competent persons, and for eliciting the various opinions which may be held both upon the main point, *i.e.*, the value which should be assigned to the company as a military body, and upon the two minor points upon our notice board, our conclusions as to which must be in a great measure based upon our decision with regard to the first part of the subject. This opportunity has been afforded to me by the Committee of the Royal United Service Institution, by their kind acceptance of my offer to read a paper on the subject, for which I tender them my thanks. At the same time allow me to say, Sir, that your presence in the chair is extremely gratifying to me, not only on account of the honour it confers upon me, but also because I hope to induce you to give us the benefit of your opinion upon the matter before us, thereby setting an example which will, I trust, be followed by some amongst the able and experienced soldiers present, in which case we shall not spend this afternoon unprofitably to the service.

In order to form a just estimate of the value of the company as a military body, it will be as well to commence by giving a glance at its previous history in this, as well as in other countries, at the causes which have contributed to increase or diminish its importance, and at the position which it at present occupies at home and abroad.

A lover of antiquarian research might perhaps point to Jethro, the Priest of Midian, as having originated regimental organization, when he suggested to Moses the appointment of "rulers of thousands and rulers of *hundreds*, rulers of fifties and rulers of tens," but his organization was rather for civil than for military purposes; and I believe that the first example we have of the *company* as an organized military body is in the standing army of ancient Rome, and strangely enough, this "remote progenitor" of the modern company had thus early attained a completeness of development from which its descendants for many centuries receded, only now in these latest times holding out hopes of returning to the original form.

For what was the "maniple" with its 200 men (the establishment in Cæsar's time) commanded by its 1st and 2nd centurions, but the strong company of the present day, with a 1st and 2nd captain, or the double-company, both of which forms have now their advocates?

The maniple, however, does not appear to have had any tactical independence, being merely used as a convenient fraction of the cohort (or battalion), for purposes of discipline and administration. The word "company," now domesticated in all the principal European languages and used in a great variety of senses, was originally invented as a military term, I don't know exactly when, but certainly by the commencement of the 6th century, for, according to Grose, it is used under the form "companio" in the Salic law which was proclaimed, we are told, in 511. The word "companio" was compounded, say the etymologists, from the two Latin words "cum" and "panis," being at first, and for long afterwards, exclusively applied to

a body of armed men raised and commanded by one leader. They took their bread, or as we should say, messed together—("cum," "panis,")—shared the same fortunes, and were subject to the same discipline, being in fact comrades or companions.

Standing armies had ceased to exist. Until their revival, and indeed for some time afterwards, companies both of horse and foot were raised for service in the field by nobles, knights, and military adventurers, being generally disbanded on the completion of the particular enterprise for which they were raised, except in the case of corps like the "free companies" which went from one theatre of war to another, selling their services to the highest bidder, holding together as long as their leaders were fortunate, and making on the whole a very good thing of it. The strength and composition of these companies varied greatly according to the requirements of the employer, and to the means and influence of the commander.

In England the *word* "company" does not appear to have been in use, as a military term, before the end of the 16th century, but the *thing* was well known, and there was a nearer approach to the comparative uniformity of modern organization here than on the continent before the revival of standing Armies. For, besides its feudal levies, England had its militia, which, according to Grose, when called out for service, was divided by Officers, called "Arrayers," into thousands, hundreds, and twenties, representing what we should call battalions, companies, and squads. All mediæval military bodies, being usually raised only for a temporary purpose, must have been more or less wanting in that cohesion which is the great element of strength in permanent formations, and which is the principal cause of the superiority which standing Armies possess over militia and other levies temporarily embodied.

Still, whilst embodied, the men of a company took their bread together, and were bound together by that great bond of union—*comradeship*—the first great moral agent which gives a special importance to the company, for this same feeling of comradeship can hardly extend to a wider sphere. When I speak of comradeship, be it understood, I refer, not only to the intimacy existing between the men of the same company, but also to that which exists, *mutatis mutandis*, between Officers and men.

Of course, when standing Armies were formed, the feeling of comradeship became intensified in the company as its members served longer together; and however great the ravages of war or disease, there were always some of the old lot left to carry on the company's traditions. Thus, too, with the revival of standing Armies, came also the revival of a moral agent not unknown to the Armies of ancient Rome, one which, however, is not confined to the limits of the company, but which has a much wider sphere, extending to the battalion, regiment, brigade, division, nay, even to the whole Army—a feeling which is, happily, very prevalent amongst us, though, oddly enough, we have no English term for it, and are obliged to borrow one from the French, namely, "*esprit de corps.*"

The company, then, has the advantage which, as I maintain, no

larger military body possesses, of being acted upon by both these great moral agents, "comradeship," and "*esprit de corps;*" and this powerful, double moral influence has affected the company, to a great extent, ever since the formation of standing Armies, thus giving it a great importance for purposes of training, discipline, and administration, whilst adding largely to its fighting power.

For a long time, however, even after the creation of standing Armies in modern Europe, this moral influence was necessarily impaired by the uncertainty as to military establishments which prevailed, more or less, in all countries, and the full development of the company's importance in this and, as I shall presently show, in other ways, has been reserved for the age in which we are living, and especially for the very latest days, if, indeed, that full development has yet been attained.

The system of permanent cadres now adopted, or in course of adoption, by every nation having any pretension to an Army, has imparted the permanency which was before wanting in military bodies, and which was required to complete the moral influences which, as we have seen, work so powerfully upon the company.

But its value has been raised, to a still greater degree, in another manner.

The maniple had, as I have already remarked, no tactical independence in the standing Army of Rome, and the same became the case with the company when modern standing Armies were formed, companies being united into regiments, the latter being afterwards subdivided into battalions, and independence of action, on the part of the company and its commander, being discouraged, or only permitted under very exceptional circumstances. The object was to impart cohesion to as large a mass as possible. The attack of cavalry was much feared, the effect of fire-arms being comparatively slight, and solidity was cultivated at a great sacrifice of mobility. Frederick the Great, indeed, imparted the latter quality to his Armies; at least, their marching and manœuvring power was great in comparison to that of the Armies opposed to them, but this comparative mobility was attained by perfection of drill and discipline, which enabled the commander to handle a long line of many regiments as one body. Thus, the regiment and the battalion lost much of their individuality, as had before done the company, and the latter made no progress as a tactical body. Frederick, however, appears to have recognized its value in other ways, for he sought to add to its efficiency by augmenting its cadre to fourteen non-commissioned Officers, that of an Austrian company at the same period consisting of six.

(I am indebted for this fact, and for some others mentioned in the course of this lecture, to General Renard's valuable little book on "Infantry Tactics," published in 1857.)

For many years after Frederick the Great's death, the so-called linear tactics which had with him proved so successful, were imitated by every European Army, and took such firm root that, in face of altered conditions of warfare, and though over and over again proved wanting and generally set aside in practice, even by those who

advocated them in theory, their spirit still haunts the parade-ground, and lingers more or less sensibly in the drill books of every European Army.

In the latter half of the 18th century, however, a school of tacticians was formed in France, who, in spite of drill regulations modelled on those of Potsdam, initiated what is called the "perpendicular" system, which powerfully contributed to the victories of the Republican and Imperial Armies. This school, of which De Broglie, Kellermann, Dumouriez, and Custine were members, all Officers who had bought their experience in the Seven Years' War, and were not blinded by the victories of the great king to the serious defect inherent in his tactical system, namely, the want of independence allowed to the minor units, that school was reinforced by Rochambeau, Lafayette, Jourdan, and the brothers Berthier, who came fresh from the American battle-fields, where they had learnt to appreciate the action of skirmishers, limited though it then was by the comparative inefficiency of fire-arms. The new French tactics, requiring much greater pliability, necessitated the employment of smaller tactical units than those hitherto in use, whilst the habit at the same time introduced of fighting on all sorts of ground, and in extended order, instead of confining the conflict to open plains where men fought shoulder to shoulder in unbroken lines, which had been the general practice under the old system, contributed to the same result by rendering supervision more difficult, and by necessarily giving greater independence to inferior Officers.

Thus commenced a new era for the company, which then for the first time since it had lost its independence by being merged in the battalion, became a tactical unit. But though the French deserve the credit of having led the way in this matter, they do not seem to have appreciated the importance of developing the force of the minor unit which their system of tactics may be said to have created.

The company made but little progress in France under the Republic and Empire, whilst in other countries it occupied a still lower position, the Potsdam principles being generally adhered to.

The Prussians above all held on, as was to be expected, to their famous linear system, to the principle of the "bar of iron," which, to use Baron Ambert's well-known metaphor, was found wanting when opposed to the "flexible chain" of the French. Jena first opened their eyes, and after the peace of Tilsit, a commission, of which the illustrious Scharnhorst was the inspiring genius, drew up a new system of regulations, which were issued in 1812, and remained in force, I believe, till 1847. These regulations gave greater tactical importance to the company, and laid great stress on skirmishing. Still the battalion was not rendered flexible enough to satisfy the far-seeing race of soldiers which had now grown up in Prussia. Reflecting, doubtless, upon the dearly bought experience of the Napoleonic wars, and upon the alterations in tactics likely to be produced by the inventions of Delvigne, Thouvenin, and Dreyse, which were in course of elaboration, they invented the company column, first introduced officially into the Prussian Army in 1843, and rendered a permanent

institution by the drill book of 1847.[1] Its merits were conclusively established in the battle fields of Bohemia and of France in 1866 and 1870-71.

There are probably many among my hearers who have made themselves acquainted with the tactical system of Prussia by personal observation. There are, doubtless, few who are not more or less acquainted with the Prussian drill regulations, and with the works of May, Boguslawski, Du Vernois, Von Scherff, Kühne, and other German writers, who describe the working of the company-column, both on the exercise ground and in action. It will therefore not be necessary for me to enter into details, even if I had the time to do so. Suffice it to say that all the battle-formations of the German Army, under Prussian inspiration, are now founded upon the "Company-column," and upon the principle that "individual order," to use their new phraseology, has supplanted the "order of masses." Hence in the German Army the company has become the most important unit of combat, and enjoys a degree of independence hitherto not allowed to it in any other Army except in that of Sweden, which has not had the opportunity of testing its efficacy in action. It is only fair, however, to state that the effects of this independence have been somewhat dreaded by many of the most experienced German officers, and that attempts have been made by regulation and precept to keep it within narrow bounds, but in vain, for throughout the great wars of 1866 and 1870-71, the company established its pre-eminence as a battle-unit on all occasions, and tactical regulations, suitable only to an earlier state of things, were compelled to give way to the necessities arising from the changed conditions of warfare.

Fortunately for the Prussians the excellent company system which had for years been growing up and perfecting itself, gave them special facilities for adapting themselves to the new order of things, and enabled them to adopt, as it were, impromptu the "individual" system of tactics which makes such great demands on company-efficiency. For as the company rose higher in estimation as a fighting body, so more was necessarily expected of it, and the fact became recognized that it would be unable to perform its task efficiently unless it possessed a perfection of training and discipline, and of inter-reliance between its members of all ranks, only to be attained by the most careful supervision and the most unremitting exertion on the part of officers and non-commissioned officers, seconded by the willing obedience of the men. The whole tendency of German company regulations is to render the Company as independent and complete in itself as possible, to make the men look up to their own officers and non-commissioned officers with the greatest respect and trust, and above all, to make them consider the Captain (the company-father as he is sometimes called), the man of most consequence to them in the whole Army, whilst the Captain by the constant habit of responsible command, and by the constant study and practice of

[1] Though the Prussians deserve the credit of inventing the company-column, they probably took the idea from Ménil-Durrand's double-company-column, advocated by him in 1770.

his professional duties, gains the quickness, decision, and self-reliance necessary to enable him to play the important part assigned to him in the field. There is only one way of attaining these objects, and that is to give the Captain the power, responsibilities, and consideration which have hitherto been only granted to him fully in the Armies of Germany and Sweden. All the other Continental Armies are now adopting, more or less completely, the same system. Of course it does not necessarily follow that that system is the best, for we are all very apt to imitate successful people merely because they have been successful, without investigating the causes of success; but I think that in the present instance investigation will show that the imitators are right, and that the Germans owe their recent triumphs in great measure to their careful development of the company, which enabled them to carry out effectively their present system of tactics, a system, the general features of which, at least, every Army will, I doubt not, be forced to imitate in war, whatever may be its drill regulations, and despite of them if necessary. Happy will it be for those Armies which have already been learning in peace what they will have to practise in war, and in which the company occupies its proper position as a military body.

With us, I think, it has never done so, and it does so less now than ever, for of late years it has certainly lost ground relatively if not positively. *Relatively*, most certainly, because notwithstanding what recent experience shows us to be the present conditions of warfare, the company has not been raised as it has been elsewhere into the position of a tactical unit, neither has it hitherto received the sort of training fitted to prepare it for that position. I think that it has also declined in *positive* value as a military body, first, because our Captains have lost much of their influence, never sufficiently great, through the constant and increasing interference from without. Instead of looking up to his Captain as his paramount chief, after the fashion of the German soldier, the Englishman knows not whom he should most honour and obey. For the first few months of his service, the Adjutant, sergeant-major, and drill instructors, are the gods whom he must worship, and to the first two at least he must look up with particular awe throughout his service. As time goes on, he falls into the hands of the musketry instructor and his sergeant, to whom he has to pay his devotions annually. Then comes the gymnastic instructor. In fact, he has so many masters beyond the limits of the company that his allegiance is too much divided, and he cannot have much reverence to spare for his Captain and the other company-Officers who instruct him only in the ordinary routine of his duty, whilst all that is unusual, and specially calculated to awaken his interest, comes to him from outsiders.

In like manner the young company-Officers have more to do with the Adjutant and sergeant-major than with their Captain, and later on they go for instruction in the higher branches of professional knowledge not to him but to a garrison instructor, thus going not only beyond the limits of the company, but beyond those of the battalion. As for the non-commissioned Officers, throughout their career, they are far more dependent on the regimental Staff than on the Captain,

whose good opinion is not nearly so important to them as that of the Adjutant. A good deal of what I complain of has grown up of late years by necessity. Improvements in fire-arms, and the general advance of military science, rather took us by surprise, and regimental Officers had not as a rule the necessary amount of professional knowledge. Hence specially trained Staff Officers were appointed, to whose zeal and intelligence the service has been much indebted. But thanks to their efforts, to the School of Musketry, and to what I think I may call the great military revival which has taken place amongst us, I hope that the time will soon come (if it has not already arrived), when the services of these special Officers may be dispensed with, and the whole responsibility of the professional education of subalterns, non-commissioned Officers and privates, may fall upon the Captain, as it does in Prussia, not excepting that portion of it which now devolves upon the regimental Adjutant, an Officer whose position is unique, for I do not believe that a subaltern in any other army occupies so high a position, and has so much influence as falls to the lot of our Adjutants. Now, I have a great respect for the British Adjutant; he is almost always a good Officer, and when he rises in rank, the experience which he has gained on the regimental staff proves most valuable to him, and I doubt not that a large proportion of our ablest Generals have been regimental Adjutants. Still I should like to clip his wings, for they overshadow greatly his brother Officers, particularly those whom I think we should do much to elevate, namely, the Captains.

My time is too short for me to enter into minute details upon this subject even if it were advisable in other respects to do so. But I will refer to one point, in which a change for the better has been made of late years with regard to the Captain's authority; namely, the increased power of punishment which has been given to him. This appears to me to be a step in the right direction. The foregoing general remarks will, as regards the rest, be, I hope, sufficient to indicate the policy which, in my opinion, should be pursued in order to give our company its due importance as a military body.

I spoke at the beginning of this lecture of more than one cause which has tended of late years to lower the position of the company. I have just enlarged somewhat at length upon what appears to me to be the chief cause.

There are two other causes, however, of great though of minor importance concerning which a few words must be said.

Up to the middle of this century, the British infantry was broken up into small detachments. There were few stations at home at which more than one battalion was stationed, and few battalions which had not some of their companies detached. This state of things, prejudicial as it was in many ways, had at least a good effect in adding to the responsibilities and influence of the battalion and company-commander, each in his own sphere. The greater concentration of troops which has been effected during the last twenty-five years has doubtless done good on the whole, but it would have done good unmixed with evil if due care had been taken to check the rage for centralization which has affected perniciously both the battalion and the company.

Again, another cause of weakness in the company has been the smallness of the home establishment generally maintained.

This has seriously affected the company both with regard to discipline and instruction. It has been impossible to carry out in earnest the squad system which we all know to be so essential to the former, whilst the number of men available for the latter is generally so small that company-drill is out of the question without an intermixture of companies. Hence company-drill, properly so called, is rarely carried out, which materially lowers the influence of the Captain and the value of the company as a military body. This difficulty of establishments is easily overcome (the change being accompanied by no increase of expenditure) in a manner which I shall point out further on. But before proceeding to consider that branch of my subject I wish to add a few words upon the main part of the question as concerning ourselves.

I believe, as I have said before, that the company has never occupied its proper position in our Army, but I ought to have added the words "in peace time," for our troops have so often been engaged in mountain warfare and other similar operations which make special demands on the smaller military bodies, and on the individual soldier, that the company has been called into independent action more frequently with us than with the soldiers of any other European nation, until the recent tactical changes. And nobly have our companies done their work on the whole; still, if we study the history of our "little wars," we shall almost always discover traces of the want of previous individual training which can only be acquired under a good company-system. Our companies struggled against the difficulties created by this deficiency, and almost always with success in the long run, meanwhile, however, suffering much loss and sometimes incurring disaster.

Unfortunately our Army did not profit by experience, and the same sort of thing was repeated over and over again.

There have, however, been cases amongst us in which Commanding Officers who have been in advance of their age have appreciated the importance of the company as a battle-unit, and who have prepared the troops under their command in peace for the part they would have to play in war. I will allude to two such cases, the first being a matter of history well known to you all. I refer to the famous Light Division, which owed much of its superior efficiency in war to the careful training and discipline of the Shorncliffe Camp, under Sir John Moore, an essential feature of whose system was to develop the importance of the company as a military body. The lessons first learnt at Shorncliffe, and afterwards impressed upon that splendid body of soldiers by many years of practice in the field, had not been quite forgotten by their descendants when I joined one of the famous old regiments of which the division was composed. In it, and, I believe, in its sister corps, the old company-spirit was pretty strong, and contributed much towards maintaining a high standard of efficiency under adverse circumstances.

Another case to which I would refer came under my own observation.

I allude to the 73rd Regiment, quartered at the Cape of Good Hope, under command of Lieutenant-Colonel (afterwards Major-General Sir William) Eyre, before and during our last Caffre war. That able Officer prepared his battalion with the greatest zeal and energy for the work which he foresaw it would probably have to perform; and, above all, took the greatest pains in training his companies to independent action.

The result justified his foresight, for throughout the war which ensued, the 73rd Regiment, though employed more than any other in the country, never, I believe, met with a check, and certainly inflicted more damage on the enemy than did any other corps.

The efficiency and self-reliance of both Officers and men in the field were very remarkable, and presented a strong contrast to the action of regiments fresh from home, which at first showed more or less want of real military instruction, a want which, in some cases, entailed severe loss. They learnt by experience, and all did their work well in the end, but they bought their experience dearly.

Having thus given my estimate of the company as a military body, with some illustrations drawn from previous history, I will turn to the second part of my subject and consider how the establishment of the company affects its value in peace and war, and what appears to be the best number of companies to unite into a battalion.

Until the latter part of the 18th century, when, as we have seen, the company rose into the position of a tactical unit, the military authorities of all countries seem to have been guided by no fixed principle in matters relating to company and battalion organization. If we examine the records of our own oldest regiments, we find a tale of alternate reduction and augmentation effected sometimes by adding to or diminishing the number, sometimes by increasing or reducing the strength of companies, sometimes by both processes. Military efficiency appears seldom to have been considered in these arrangements which were often affected by favouritism and by respect for vested interests. Nor does the case appear to have been very different abroad during the 17th and most of the 18th century; the establishment and number of companies were constantly varying.

In the latter part of Frederick the Great's reign, the Prussian battalion consisted of five companies formed for manœuvre into eight divisions, a curious and complicated process. In 1792 the French battalion had nine companies including one of Grenadiers. Soon afterwards as the practice of skirmishing gained ground, a tenth company, that of Voltigeurs, was added, the two flank companies being composed of picked men and specially employed for tasks of particular difficulty and as light infantry. This system was imitated by most of the European armies including our own, and remained in force until the general introduction of arms of precision, and the consequent extension of fighting in skirmishing order caused the abolition of flank companies.

At the commencement of this century the strength of companies ranged from 100 to 150, the flank companies being generally somewhat stronger than the others.

We have seen how the French led the way in raising the value of the company by giving it tactical importance. About the same time the Prussians introduced a change in battalion organization which has, I believe, in no small degree contributed to give the company the high position which it now occupies in Germany. In 1787, the year after the death of Frederick the Great (I am indebted for this date to General Beauchamp Walker), the four-company formation was introduced. It has been maintained ever since in Prussia, and is now, as we shall see presently, being adopted in all the great armies of the Continent.

I believe that the change of organization was due, in the first instance, not to considerations of military efficiency, but rather to motives of economy, for it does not appear to have resulted in any immediate tactical improvement; and it was doubtless accompanied by a considerable reduction of Officers and non-commissioned officers, retrenchment in military expenditure being just then the order of the day in Prussia. But, as time went on, and as the value of the company became better understood, the great advantages, consequent on the system adopted in 1787, became evident, and it was maintained for reasons very different from those which led to its first introduction.

From the date of the French revolutionary war, all nations appear to have become more systematic in their arrangements as to military organization. The French for some time adhered to the ten-company formation, for which they afterwards substituted that of eight, and in later times that of six, in which they fought their last battles.

I have not ascertained what was the formation of theAustrian and Russian battalion during the Napoleonic wars, but in later days, up to 1866, the former consisted of six companies formed for manœuvre into three divisions, each company being divided into four sections, whilst the latter had at the time of the Crimean war, four companies each of two sections, No. 1 company being composed of picked men, and one of its sections forming on each flank of the battalion. The strongest regiment engaged at Inkermann mustered, according to Todleben, an average of 244 men per company; the weakest an average of 198 men. The Russians had, shortly before the Crimean war, adopted the Prussian company-column formation, but fortunately for us, in the letter and not in the spirit, for there was very little of that independent self-reliance in the Russian companies which characterises those of Prussia. Since the war of 1866, the Austrians have adopted the four-company formation with establishments similar to those of Prussia, and their last regulations give an importance to the company, not inferior to that possessed by it in the army of their great neighbour. After the Crimean war, the Russians added a company to their battalions which were thus made to consist of four battalion-companies, and one light company. This formation has been maintained ever since, but I saw in the "Revue militaire de l'Etranger," (number of the 16th April) that the 5th companies were by degrees to be abolished, so that battalions will again consist of four companies, but without any distinction between them, a much

more rational plan. The war strength of the present Russian Company is about 190.

Italian battalions used to consist of six companies, after the fashion of the French, but Italy has lately adopted the Prussian plan, after a thorough discussion of the subject in Parliament, and the Italian company is fast attaining the importance enjoyed by those of Germany, Sweden, and Austria.

The French have been much divided in opinion upon the subject. Ever since the late war there have been amongst them many advocates of the Prussian company-system, but also many strong opponents to it, some of the latter being, I think, somewhat influenced by their prejudice against anything coming from the other side of the Rhine. However, the question was most fairly and exhaustively discussed upon its merits in the National Assembly at the beginning of the year. The debate is given fully in the "Journal Officiel," and is both interesting and instructive. It has resulted in the adoption of the four-company battalion, with a war establishment resembling that of Germany, but with what appears to me an insufficient peace establishment, insufficient, I mean, to maintain the efficiency of the Company, which will on the peace-footing be composed as follows:—

Officers 3.		Non-commissioned Officers, 14.	
Captain	1	Sergeant-Major ..	1
Lieutenant	1	Quartermaster Sergeant (Fourrier) ..	1
Sub-Lieutenant ..	1	Sergeants	4
		Corporals	8

Drummers or buglers	2
Privates, including 2 pioneers	66
Total, all ranks	85

The cadre is out of all proportion to the number of privates, so as to allow for partial expansion for the annual manœuvres, and for augmentation to the war footing, which would raise the number of privates to about 200, the cadre being then also increased by 1 subaltern, 1 quartermaster-corporal (caporal-fourrier), 4 sergeants, 8 corporals, 2 drummers.

And now let us turn to our own country and see what we have been doing in this way since the beginning of the century. During the "great" war, as we English may still call it, our service battalions consisted generally of ten companies of about 100 men.

(By the way, I will only deal with the service battalion, as I have no time to enter into the depôt question, though it should properly be a branch of my subject.)

Since 1815 more attention has been paid to military considerations as affecting company efficiency than was the case before the war. The service-battalion has consisted at different periods of six, of eight, and of ten companies, each of which arrangements may have been

good as long as it was allowable to adhere to the system of tactics under which Wellington's armies fought and conquered. Of course during the Crimean War and the Indian Mutiny, the only great wars in which this country has been engaged since 1815, every other consideration gave way to those of a military nature, and the establishments were suited to our supposed requirements; but in the long intervals of peace this has not generally been the case, and military efficiency has too often been subordinated to political expediency and to the exigencies of party. Thus there have been statesmen on both sides of the House who inveighed whilst in opposition against the parsimony and neglect of those in office, and who, on succeeding to power, have, after a decent interval, done their best to vie with their predecessors in the art of retrenchment. I think we have reason to hope that those times are over, that the question of the national defences will no longer be discounted for party purposes, and that all parties will agree that there is no true economy without efficiency, and that the latter is not a plant which springs up all at once, but that it is the result of constant care and cultivation. Meanwhile party strife has often been productive of evil to the British Army, and has in great measure been the cause of the constant fluctuations in our military establishments, which it has been the policy to reduce to the utmost minimum compatible with bare existence, except when the state of foreign affairs has produced a momentary panic, and its consequence, army augmentation. Of late years, however, as public opinion in this country has become more enlightened upon military matters, the conviction has been gaining ground that such things should not be left to chance and to the caprice of the moment, but that both the peace and war establishments of our military bodies should be, as far as possible, permanently settled, in accordance with the practice now prevailing throughout Europe. Arrangements of this nature have been made, and the result at present is as follows, as far as concerns the question before us:—Our service-battalions consist of eight companies, the peace establishment of the latter ranging (as is necessary, I suppose, in consequence of the peculiar exigencies of our foreign peace service), from—

Lowest Peace Establishment.

1 Captain, with one or two subalterns.
4 Sergeants, including colour-sergeant,
2 Drummers,
5 Corporals,
60 Privates, including 1 pioneer and, on an average, 3 musicians,
Making up a total per service battalion of
605 all ranks, to—

Highest Peace Establishment.

1 Captain, with two or three subalterns,
5 Sergeants, including colour-sergeant,
2 Drummers,
5 Corporals,

98 Privates, including pioneer and musicians as before,
Making up a total per service battalion of
919 all ranks.

According to the "Soldier's pocket book," the war establishment of our service companies is fixed at

War Establishment of a British Company.

1 Captain, with two subalterns,
5 Sergeants, including colour-sergeant,
2 Drummers,
5 Corporals,
119 Privates, including pioneer and musicians as before.
Total per company, all ranks, 134.
Total per field-battalion, all ranks, 1,097, including 4 hospital orderlies.

Compare the foregoing with the peace and war establishments of a German company and battalion.

Peace Establishment of the German Company.

1 Captain,	1 Sergeant-Major,	115 Privates, including
1 First-Lieutenant,	1 Officer Cadet,	4 Musicians,
2 Second-Lieutenants.	4 Sergeants,	2 Reserve Musicians.
—	7 Corporals.	
4 Officers	—	
	13 non-commissioned Officers	

Total all ranks, 4 officers, 128 men, besides 1 hospital orderly and 3 tradesmen, non-combatants, making per *battalion*, 18 officers and 514 men, besides non-combatants.

War Establishment of the German Company.

1 Captain,	1 Sergeant-Major,	6 Musicians,
1 First-Lieutenant,	1 Officer Cadet,	223 Privates.
3 Second-Lieutenants.	4 Sergeants,	
—	14 Corporals.	
5 Officers.	—	
	20 non-commissioned Officers.	

Total, 5 officers, 249 men, besides 1 hospital orderly and 2 drivers, making per battalion, 22 officers, 998 men, besides non-combatants.[1]

I trust that you will consider me justified in making the following assumptions. At any rate I must beg you to allow me to do so, if only for the sake of argument. I will assume then—

1. That "individual order," and not the "order of masses," will, in future, be employed in battle.

2. That, in consequence, the minor units, and notably the company, have acquired a great increase of importance.

[1] From "Heerwesen, &c." By Lieut.-General v. Witzleben.

3. That the company is not only *the* most important battle-unit, but is also *the* great school of military instruction and discipline; in short, to use General v. Witzleben's words, "der Grundpfeiler unserer militairischen organisation" (the basis of our military organization); "die Familie im militairstaate" (the family of the military world).

4. That a wise organization is the first step towards making this "basis" solid, this "family" united.

We have before us, speaking in a general way, three patterns to choose from, each of which has its admirers—

1. That of few companies and large ones.
2. That of many companies and small ones.
3. That of many and small companies united by pairs for tactical purposes.

The maximum number of companies being eight to the battalion, the minimum number four.

To which system will you give the preference?

I myself am inclined to favour the first system for the following reasons—

1. It is the system which makes the company of most importance for instruction, for discipline, for battle.

For instruction; because it ensures the Captain a sufficient number of men to make "company drill" a reality and not a sham, promoting thus both his own military *education* and that of his Officers, non-commissioned Officers, and privates; and by *education*, I mean, as you will understand, a great deal more than *drill* or even *training*.

For discipline; because, the higher the position of the Captain, the more constant his intercourse with his men, the greater becomes his influence over them; and there has been no period since the formation of standing armies when the personal influence of the leader was as powerful an agent in war as it is now.

Moreover, in a strong company the "squad" system can be maintained in its integrity, and nothing conduces more to discipline and efficiency than a squad system properly carried out. Amongst its other advantages it serves to train subalterns and non-commissioned Officers to the exercise of responsibility, and to the habit of self-reliance. The effect of the presence or absence of such training will be clearly shown on the battle-field; for, as battles are fought now-a-days, the intelligent co-operation of inferior leaders of all ranks down to the junior lance-corporal is called into play.

For battle; because, in addition to the advantages accruing to the company in action, on account of the superior instruction and discipline already claimed, I think that the tactical advantages derived from the four-company system are great. Without going into details, for which there is no time, and which might weary you beyond endurance, the chief merits of this organization, from a tactical point of view, seem to be, firstly, that it reduces to a minimum the subdivision of command. Such subdivision being, I think, under the present conditions of warfare, unavoidable, I would reduce the number of sub-unit leaders as much as possible, both for the sake of maintaining a general unity of action, and also on account of the difficulty of finding

a sufficient number of capable leaders. But I would not reduce the number of companies per battalion below four, because we should then have unwieldy companies or too small a battalion. Secondly, that it provides us with a strong company capable of performing the part now required of it in battle, of which a weak company would be incapable, particularly after it had undergone the wasting effects of even a few weeks' campaigning.

The only argument of any weight which I have heard against the four-company system is, that it provides us with a company too large for one leader to control in action, assuming the field-battalion to be, as I think it should be, not less than 1,000 strong.

But I would reply to this objection; firstly, that the company will, from the very first moment show far fewer men on parade than the number shown on its muster-rolls, and that its fighting strength will be reduced day by day until drafts have been received from home; secondly, that the difficulty of command in battle will be much diminished for the Captain who has trained his subalterns and non-commissioned Officers to that intelligent co-operation of which I just now spoke, and which alone will render it possible to command a company efficiently in war.

As to the system of "many and small companies united by pairs for tactical purposes," in other words the "squadron" or "division" system, it seems to me radically wrong in *theory*, because the commander of the double-company in the field will only command half his unit in quarters. Over the other half, therefore, he cannot exercise the direct personal influence so necessary to his position.

In *practice*, it has been tried and has been abandoned by two of the greatest military powers, France and Austria.

Having settled, to my own satisfaction at least, that the four-company system is the best, I will propose establishments which appear to me suited to the object in view, giving my reason for any departure from the ordinary custom, and taking care to keep within our present battalion establishments.

Proposed lowest Peace Establishment of the Company.

1 Captain-Commandant (or Major) 1 Captain .. .. 3 Lieutenants	Officers 5.
1 Sergeant-Major .. 1 Quartermaster-Sergeant 6 Sergeants .. .. 6 Corporals .. .. 6 Lance-Corporals ..	Non-commmissioned Officers 20.
3 Drummers and Buglers	3
120 Privates, including 6 Bandsmen, 1 Acting-Bandsman, and 2 Pioneers	120
Total, all ranks	148

Battalion Staff Officers	4
Non-commissioned Officers	7
Battalion total. Officers	24
Men..	579

Proposed War Establishment of the Company.

1 Captain-Commandant (Major)	Officers 6.
1 Captain	
4 Lieutenants	

1 Sergeant-Major ..	Non-commissioned Officers 20.
1 Quartermaster-Sergeant	
6 Sergeants	
6 Corporals	
6 Lance-Corporals ..	

Drummers and Buglers	4
Privates, including 6 Bandsmen and 4 Pioneers	230
Total, all ranks	260
Battalion Staff. Officers	4
Non-commissioned Officers	7
Battalion total. Officers	28
Men	1,023

besides non-combatants.

Many object to the idea of having two captains for the company, and I think it would be very objectionable unless you distinguished the senior from the junior both by giving him a higher title and higher pay. Call him either Captain-Commandant, or Major, and give him 15*s.* a day and forage for a horse, for he should be a mounted officer. With the increased amount of work which I propose to be thrown on the company, I do not doubt that plenty of occupation would be found for the Second Captain even when the Commandant is present. During his absence, of course the Second Captain would be in command. The company would be divided into three squads (or sections on parade). Each of these squads under a Lieutenant. The war establishment would give a fourth Lieutenant to provide for a casualty. I propose three instead of four squads or sections, because I think that owing to their greater strength, as thus arranged, the squad system would be more efficiently carried out, because the three-section formation appears to have some tactical advantages, and also because it demands a comparatively small proportion of non-commissioned officers.

Sections would be subdivided into half-sections, each of which under a sergeant. The half-sections would be again sub-divided into fractions, for which we must invent a name, each under a corporal.

There would be two lance-corporals in each section to assist the other non-commissioned officers. Lance-corporals should receive higher pay than privates.

All non-commissioned officers should be out of the ranks; that is to say, either as leaders of sections, half-sections, &c., or as supernumeraries. The sergeant-major would be head of the company non-commissioned officers, and would perform all the duties now devolving upon the colour-sergeant, except those relating to the charge of arms, ammunition, clothing, accoutrements and other stores, and to the supply of provisions, fuel, and such like, which would fall to the lot of the quartermaster-sergeant. As company work would be largely augmented both by the increased size of the company, and by the proposed redistribution of regimental duties, there would be ample occupation for two company staff non-commissioned Officers. I propose reducing the battalion staff by one Officer, the Quartermaster, because I think that the diminished duties of both that Officer and of the Adjutant may well be performed by the latter. I propose relieving the subaltern filling the office of musketry instructor of his special duties which may in future be performed by Captains of companies. I propose also doing away with the sergeant-pioneer, sergeant-cook, and sergeant-instructor of musketry, whose services can, I think, now be dispensed with.

The proposed change of organization would produce the following saving on the daily pay of a battalion on the lowest peace footing :—

		£	s.	d.	
By	1 Quartermaster	0	6	6	per diem.
	1 Lieutenant	0	5	3	
	1 Sergeant-pioneer	0	2	2	
	1 Sergeant-cook	0	2	2	
	1 Sergeant-instructor musketry..	0	3	2	
	Extra pay of musketry-instructor	0	2	6	
	16 Corporals	1	4	0	
	4 Drummers	0	5	0	
	Total saving	£2	10	9	

But as my motto is not "economy by retrenchment," but "economy by efficiency," I propose devoting my savings to the following purposes :—

			Per diem. £	s.	d.
Extra pay for	4 Captains-commandant at	3*s*. 5*d*.	0	13	8
,, ,,	24 Lance-corporals at	1*s*. 2*d*.	1	8	0
,, ,,	4 Sergeant-majors, at	6*d*.	0	2	0
,, ,,	1 Battalion ditto, at	1*s*.	0	1	0
,, ,,	1 Lieut.-Colonel-Commandant at 3*s*.		0	3	0
Forage for	4 Captains' horses, at	2*s*.	0	8	0
	Total extra expenditure		£2	15	8

Leaving us *aparently* 4*s*. 11*d*. out of pocket, but *really* not so, for more than this sum would be saved on the *allowances* of the reduced Officers and non-commissioned Officers. Moreover, my establishment would provide 24 more combatants per battalion than does the one with which it is compared.

Only one word, Gentlemen, in conclusion. I have heard it said that we should never get the British Captain to do the amount of work which I have proposed to cut out for him. I believe that, speaking generally, this is a calumny upon our British Captains, and that the great majority of them would welcome what I will venture to call a reform which would give them *real* responsibility and *real* influence, though coupled with extra work. At the same time I desire to guard myself against the imputation of wishing to raise the Captains at the expense of the Colonel. Far from it. I wish to raise him in like proportion, and I believe that one sure way of doing so is to relieve him of many petty cares and duties which under our present system devolve upon him, but which should be taken off his hands by the Captains, thus leaving him more time to devote to his higher functions.

I am aware that I have not made the best of my case, having omitted much which might be said in support of my views. But I felt that the time at my disposal was too short to give more than a slight outline of the picture, which I hope those who think with me will complete, whilst those who disagree with me do their best to point out its defects.

P.S.—Since writing this paper, an important tactical memo. has been issued by order of His Royal Highness the Commander-in-Chief, upon which it would of course be unbecoming in me to make any critical remarks. But I think I may say, with perfect propriety, that I welcome this memo. as a boon to the service, because it appears to me to contain the recognition, hitherto withheld, of a tactical principle materially affecting the action of infantry in battle, also because it is a step towards that development of the company as a battle-unit which I have been advocating. I doubt not that it will soon be found that further steps must be taken, in order to make our companies equal to their new task, and that, to use the words of a recent article in the "Revue Militaire de l'Etranger," upon the necessity of a similar reform in France, we shall "profit by the experience of our neigh- "bours," and whilst using the "most legitimate efforts to mould the company into an instrument for battle which our infantry does not at present possess, we shall be careful in no way to depreciate the value of that other important unit—the battalion."

The CHAIRMAN: I am sure that we are obliged to Sir Lumley Graham for having introduced this subject to our notice. I will not state my own opinions at present, as I am sure there are people here who would like to discuss it, and I hope that we shall have an interesting subject worthily handled.

Colonel the Hon. PERCY FIELDING, Commanding Coldstream Guards, said that he entirely agreed with everything that Sir Lumley Graham had stated.

Lieut.-General Sir HAMILTON GORDON: I should like to ask Sir Lumley Graham

if he can inform us what is the war establishment of a French company? He has stated the peace establishment, and the commissioned Officers and non-commissioned Officers of the war establishment, but I do not think he has stated the number of privates on the war establishment. Where do you find that?

Sir LUMLEY GRAHAM: I may as well answer that question at once. With regard to the war establishment of the French company, I think I stated that it was supposed to be made up to about the same as the Prussian war establishment. I find it only in a casual way. I do not think the war establishment has yet been finally settled; but I find it casually alluded to in that discussion in the French Chambers of which I spoke.

Sir HAMILTON GORDON: It is a remarkable thing. In the elaborate law they have issued for the organization of the French Army they omit to mention the war establishment of the company.

Sir LUMLEY GRAHAM: They do not give it in the Tables, but I inferred from a statement, I think, of the Minister of War, that the establishment was intended to be about the same as that of the Prussian battalion.

The CHAIRMAN: This question is one of great importance to our Army. It is the introduction of a great change—a thing which, perhaps, Englishmen do not much like at first. One of the main points would be, whether the 250 men of the four-company system are not a very large number for an Officer to manage, unless you consider him as the mounted Officer commanding what we should call a battalion. In the Prussian system, the Captain is mounted nominally, but has to dismount when he is in charge of his company under fire. I do not know whether it is very practicable to command 250 men under fire, unless it is at the last moment, when you must advance with the men to the attack; because 250 men extended (which I apprehend is the first line of attack of the Prussian Army), is a large number, covering much space when extended in open order, and difficult to command on foot. I do not suppose that any one can differ with Colonel Graham, that the company is the foundation of the military system of almost every nation, and ought to be so. It is the means by which the men are known to the Officer who commands, more particularly if he pays them, and is in the habit of that constant communication that takes place between them. The double Company is rather excluded by Colonel Graham, and I quite agree in the exclusion, because you then mix up two separate authorities. I cannot myself conceive, either when manœuvring or fighting, why there should be that mixture of two companies under one Officer, who, nominally superior, might be superseded or replaced by a man who is not known to the rest of the two companies, mainly by quitting his own company for the command of the two, if he becomes the senior. The Prussians have considered the necessity for having the Officers mounted. I noticed Colonel Graham at first said, that our companies have not had the general independence that he considers they ought to have; but he afterwards a little corrected himself, when he spoke of what occurred in war, for I suppose in no Service in the world, certainly in no better record of it than in "Napier's History," has there been shown a greater independence of the company, or a more trusting feeling on the part of men to their officers, than in the several actions that we read of in that history. I think we are peculiarly strong when the company Officer has the means of really being with his men in action. They are attached to their Officers, and the company influence is as great as in any Service in the world. I do not know that you would increase that influence by making it so much larger. There are many other observations that might be made on this subject; but I hope that other gentlemen who have experience in the habits and discipline of our regimental system will give us the benefit of their opinions, for it is most valuable that we should know them. I do not know whether Colonel Graham would wish to make any other remarks.

Sir LUMLEY GRAHAM: With regard, Sir William, to what you just said about our Army in the Peninsular War. Of course, we all know how intimate are the relations between the British Officer and the soldier in the field; how well the Officer looks after the soldier, and the soldier looks up to the Officer. But still, I think the independent tactical working of the company has rather grown up in the field than been taught before-hand; that is rather what I alluded to; the English company has succeeded rather in spite of the peace system than in con-

sequence of it; and I mentioned those exceptions that were known to me, in which a company had been prepared in peace for what it had to do in war. With regard to the difficulty of commanding a strong company in action, I think that difficulty perhaps may be more apparent than real; first of all, from the fact that we never have a company anything approaching the nominal strength actually in action. Supposing my proposed establishment provides for 220 fighting privates, if I had 180 of those privates to fight under me, as a Captain, in the first battle I was engaged in, I should think myself very lucky. You will bear me out in saying that would be as large a proportion as I should have a right to expect. That would allow me only 170 privates; that reduces my difficulties very much of command, and I think my difficulties would be reduced even more by the careful training of the subaltern and non-commissioned Officers; that is how, in Prussia, the Captains manage to control their large companies. There is such a thorough understanding by the inferior Officers, that they all know almost by instinct what the Captain wants them to do. I think in that seems to lie the secret of the power of commanding large companies, and that of course can only be attained by constant practice.

The CHAIRMAN: In our Service you must take off one-fourth.

Sir HAMILTON GORDON: I think you will not find the Prussian Officers dismount under fire, but only at the time of attack.

The CHAIRMAN: I do not know the exact rules. I remember the tactical retrospect made in the Prussian Service, in which the great fault then found with the company and company column was, that every one went to the front. You will remember there was a case in which every soldier, non-commissioned Officer, and even the Generals, went to the front, and they all joined the fighting line, and that made an enormous extent of line, scarcely controllable. That, I remember, was the effect of making that fighting line. That I cannot say.

Sir HAMILTON GORDON: Did they all dismount? I have made special inquiries on that subject. It is only at the time of assault that the Officers dismount, and not merely when they come under fire.

The CHAIRMAN: Not in the preparation to do so?

Sir HAMILTON GORDON: No. Is not there some new order from the Horse Guards about mounted Officers dismounting?

Sir LUMLEY GRAHAM: Contained in the memorandum of last week.

The CHAIRMAN: That memorandum is very much in accordance with the Prussian system. If no other gentleman wishes to make any remarks, I am sure that we may thank Sir Lumley Graham for his lecture, which contains points of very great interest, and is a subject which we are all very glad to hear discussed. I only wish there had been more Officers present to give us their opinions.

LECTURE.

Friday, June 25th, 1875.

Lieut.-General Sir FREDERICK W. HAMILTON, K.C.B., Colonel 21st Royal North British Fusiliers, in the Chair.

UPPER BURMAH: ITS DEFENCES AND WARLIKE RESOURCES.

By Captain EDMOND BROWNE, 21st Royal North British Fusiliers.

I SHOULD not have had the boldness, Sir Frederick Hamilton and gentlemen, to address an audience like that which is before me to-day, on this platform from which so many distinguished soldiers and sailors have from time to time given their views and experiences for the improvement of our Army and our Navy, were it not that I had hoped to make up for my want of ability as a lecturer, by surrounding my subject with the interest which generally attaches itself to the narration of *personal observations*, for when I was quartered with my regiment at the little frontier station of Thayetmyo, some three years ago, I obtained leave from the Chief Commissioner of British Burmah, to visit the capital of the King of Burmah, and to pass up the Irrawaddy, as far as Bamò.

I went there with the sole object of examining and reporting upon the defences and warlike resources of the country, with a view that the information thus privately obtained might be of public advantage in case of a future campaign.

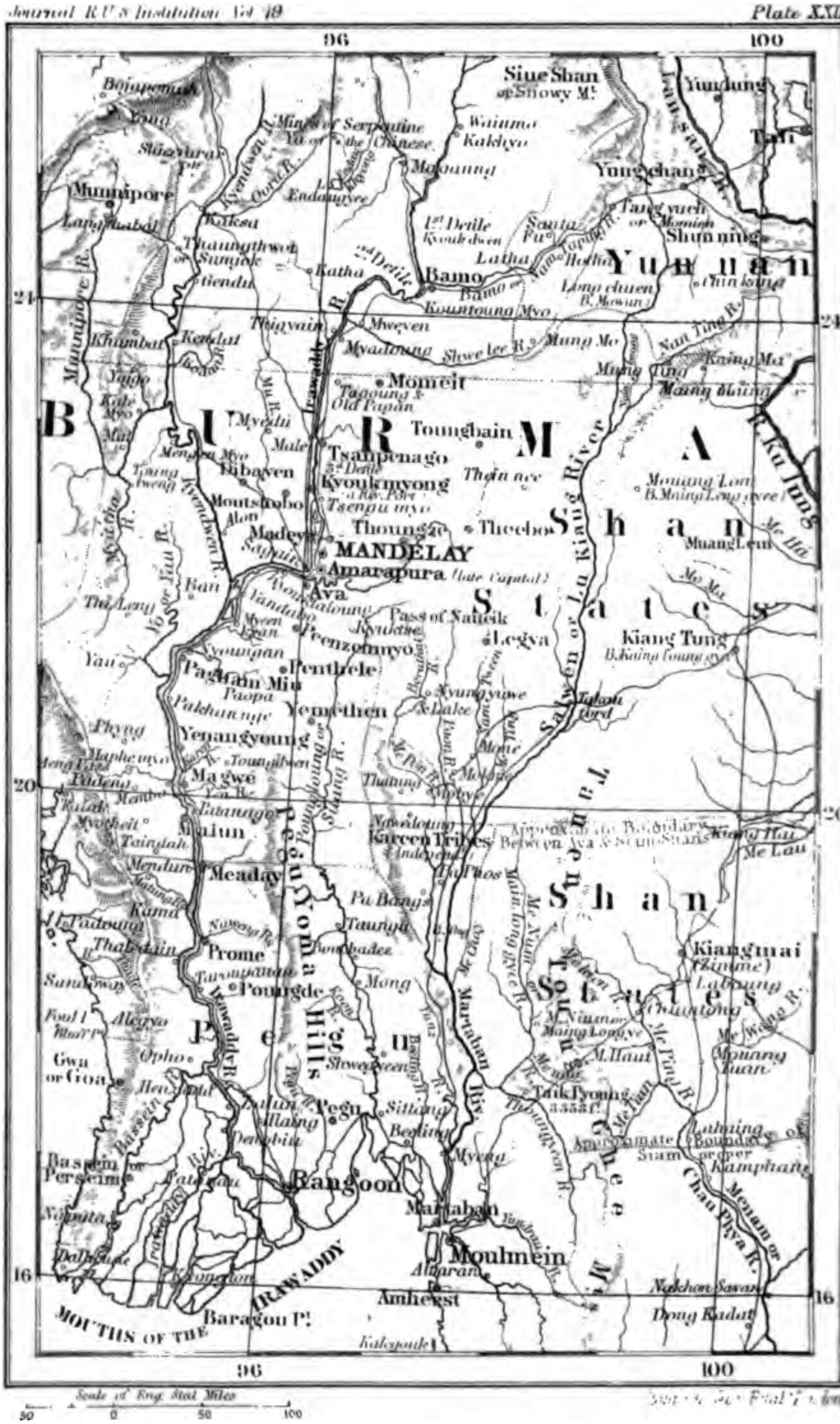
In the first place then, gentlemen, I will ask you to turn to the map.

Burmah, you will observe, is bounded on the west and south by the Bay of Bengal, on the east by the Shan States and China, and stretches northward to the mountains of Thibet, occupying, it is estimated, 44,450 square miles. It is intersected by the three rivers, the Irrawaddy, the Sitang, and the Salween.

Ranges of lofty mountains rise between the rivers—the most important, the Arakan hills, intervening between the valley of the Irrawaddy and the sea.

Countless streams, rising in the mountains, flow into the great rivers, swelling their waters, and at every step obstructing the advance of the traveller. These streams are deep, sluggish and muddy near their mouths.

The Irrawaddy rises in the mountains of Thibet, and for the first two hundred miles has a contorted channel and consists principally of


96
100
24
20
16
Siue Shan
or Snowy M!
Yunlung
Munnipore
Yungchang
Shunning
Yunnan
Bamo
Katha
Mweyen
Momeit
BURMA
Toungbain
Tsampenago
Kyoukmyong
MANDELAY
Amarapura (late Capital)
Ava
Thoungze
Theebo
Shan States
Pass of Natteik
Legya
Kiang Tung
Salween or Lu Kiang River
Yenangyoung
Magwe
Meaday
Prome
Poungde
Pegu Yoma Hills
Kareen Tribes
Pegu
Rangoon
Martaban
Moulmein
Amherst
Baragou P!
MOUTHS OF THE IRAWADDY
Bassein or Persein
Gwa or Goa
Kiangmai
Shan States
96
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Scale of Eng. Stat. Miles
50 0 50 100

rapids; as it approaches Bamò, however, it widens out and is navigable for small steamers throughout the remainder of its course. The Irrawaddy falls nearly forty feet in the dry season. The Sitang which appears on the map next on the right of the Irrawaddy, takes its rise in the mountains east of the present capital of Burmah, and pursuing a course almost parallel to the former, enters the sea near the ancient city of Pegu. It is navigable for small steamers as far as Shuygyn, about half way to the British frontier station of Thoonghou. Troops are conveyed up the Sitang in Burmese boats, and the navigation is generally attended with some danger in consequence of the *bore*, a tidal wave, or bank of water which rushing up the river, overturns and swamps all boats with which it comes in contact.

The third great river, the Salween, rises in the mountains of Yunan, and flows in a south-westerly direction, till in the vicinity of the mouth of the Sitang, it takes a south-easterly course and enters the sea at Maulmein. Navigation is difficult and dangerous throughout.

Large quantities of teak are floated down the Salween from the extensive forests on the north.

Looking at the map of Burmah then, such appear to be its general features. I will next proceed to give you in detail some account of the great Irrawaddy which is the principal artery of the country, and on the banks of which are situated all the principal towns. I will proceed northward from the sea to the city of Bamò, a distance of about 600 miles, up to which point I can speak from personal observation.

The Irrawaddy, as will be seen by the map, enters the sea by numerous mouths, forming a huge delta like that of the Ganges. On one of these branches is situated the rising and prosperous city of Rangoon; a somewhat narrow but deep and navigable creek communicates from Rangoon with the main channel of the great river, which it enters some miles south of the town of Donabeu. From this place to the city of Prome, the river is about two miles in width, abounds in shoals and sand-banks, and requires careful navigation. Some twenty miles further north, the boundary of British territory is reached.

The town and fort of Thayetmyo is the most northerly point occupied by British troops. The river here is about a mile and a half in width at the end of the Monsoon, of which time I write, but much less in the dry weather, and the current is at all times powerful.

Travelling upwards, a lofty range of hills lines the left bank for some fifteen miles, when it takes a westerly direction. The east bank is low and covered with thick jungle. Many villages appear on both banks, but there is no sign of extensive cultivation.

From this point till the town of Mengla is reached the course of the stream, divided into two channels by a large island, is twisting and irregular, the banks lofty and wooded. The Burmese made a stand here in the war of 1826.

Mengla is a town of about 5,000 inhabitants. A few miles north of this town another stand was made by the Burmese, who erected a stockade on the neck of land formed by the Irrawaddy and the Yen, which joins it here.

The next places of importance are Mugway on the left bank and Memboo on the right, both considerable towns; the heights surrounding these places are thickly studded with white pagodas. Memboo is the nearest point to the Aeng Pass, which leads over the Arakan hills into Arakan. Twenty miles further north is another pass which General Morrison attempted unsuccessfully to cross with his army in 1826.

Ye-nan-Jioung, situated in an inlet of the great sandstone cliffs, is celebrated for its petroleum wells.

The character of the country now changes, the thick jungles disappear and the land has a parched and inhospitable appearance. On the left bank is the site of the ancient sacred city of Pagan, a space of seven miles in length and two in breadth, being literally covered with the ruins of temples and pagodas of every conceivable shape and size, in all stages of decay. These ruins point to the fact that this part of the world must have once been the centre of a populous and enterprising district. It was at this place that the Burmese made their last attempt to check Sir Archibald Campbell's force in 1826. The river here is of immense breadth and continues to flow in the same direction till some fifty miles further north, when it bends at right angles, and after a few miles, steering an easterly course, the traveller comes in sight of the ruins of the ancient capital which has given its name to the once famous and powerful kingdom of Ava.

Nothing now remains of the old place but crumbling walls, rotten stockades, and shapeless mounds of earth which once were parapets. It is strongly situated by nature, being surrounded by water on three sides.

Opposite to Ava, embosomed in a thick wood, lie the ruins of Tsagain, another ancient capital.

The Irrawaddy once more alters its course at this point, flowing north and south—and is cut up into several channels by wooded islands.

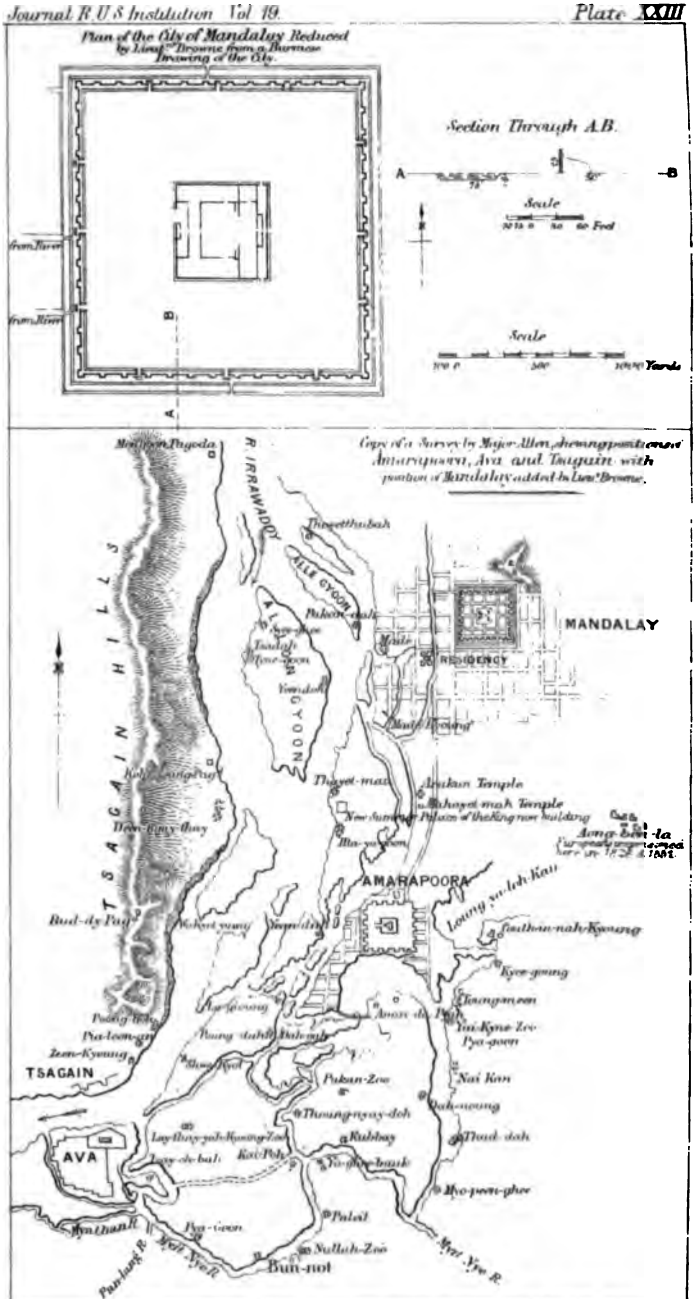
Amarapoora, the late capital, only discarded by the present King in 1858, appears in an inlet of the river about five miles from Ava. The wall and ditch which formed the defences of the city still remain in fair preservation, but the place has been almost entirely deserted by the Burmese and is chiefly occupied by Chinamen.

Mandalay, some seven miles further north, is the present capital of Burmah, and is situated about two miles from the river's bank at the foot of an isolated hill 600 feet in height and now crowned with several Buddist temples.

The city is laid out in a perfect square, the sides of which run due north and south, east and west, and are, as near as possible, one mile in length. It is rendered secure against attack in the following manner:—

A solid brick wall about 25 feet in height and 3 feet in thickness surrounds the city. Behind this an earthen parapet about 30 feet thick has been thrown up, which being raised to within about 4 feet of the top, is allowed to slope away towards the interior; no revetment is attempted.

There is little attempt at flanking defence, at intervals of about 150 paces buttresses protruding, while at the angles two of these



Scale
0 1 2 3 4 Miles

Sandford's Geog. Estab.t 6 Charing Cross

meeting have something the form of a bastion. The wall is not loop-holed or provided with embrasures for guns, the top being crenellated after the fashion of our ancient castles.

Each of the four sides of this wall and rampart is provided with three gateways constructed of masonry of immense thickness and solidity: the gate in the centre of the passage which is about 15 feet in width is of teak wood studded with iron nails; and is about 20 feet in height and one in thickness. All the twelve gateways are similar in construction and are protected on the outside by traverses of solid masonry, so placed as to completely protect the passage.

A moat of about 100 feet in breadth, and 6 or 7 in depth, encircles the city; the escarp of the ditch being cut at about 60 feet from the walls, leaves a fine road between. This moat is kept full of water all the year round, except on the south side, which was not completed when I visited the city. One bridge crosses it, on the south, east, and north sides, each; and on the west, that which faces the great river, two. No precautions have been taken to defend these bridges.

The roads in the interior of the city are wide, but unmacadamized, being much broken up at places. They run in the same direction as the walls, dividing the city into rectangular blocks of houses.

In the centre of the city is the palace of the king, about 350 yards square, and surrounded by a stockade 20 feet in height, and constructed of teak stakes, 9 inches in diameter, firmly bound together by bars of the same wood passing through them horizontally.

The palace is divided into three enclosures, after the manner shown in the plan. There is a brick wall inside the stockade, then an esplanade of considerable width, another brick wall, until the inner enclosure is reached.

There are three entrances to the palace, the main and only public one being situated in the centre of the east side; the two smaller ones are near the eastern ends of the northern and southern faces.

The reception hall of his Majesty is remarkable for its barbaric splendour, walls and pillars being loaded with gold leaf, but dirt and neglect pervades all.

The whole of the arms, ammunition, and valuables of the kingdom are stored within this "Holy of Holies."

I saw everything that was to be seen, except the "noble savage" himself, who excused himself on the plea of illness.

The big guns were numerous, but were in an unserviceable condition, and I was informed that there was no ammunition, but that, in case of war, plenty could be obtained. No trained gunners.

There were a couple of thousand stands of arms—old muskets, rifles, and double-barrelled guns, all mixed up together in the arm-rack. They were all rusty, and shamefully kept.

The place was guarded regularly by sentries, who strolled about or squatted under the verandahs, and appeared too lazy even to be attracted by the brilliant uniform of my companion—a Captain in the Royal Navy.

I should say that the king could not assemble more than 3,000 trained soldiers for the defence of the place, but this number would

be swelled by raw levies raised in the vicinity of the capital and withdrawn from the country.

The inhabitants of Mandalay number 20,000 within the walls, and 60,000 without.

The population is made up of natives of India, Munnipoor, and Chittagong, Shans, Siamese, and Chinese, all of whom intermarry with the Burmese. The Chinese are by far the most thriving and prosperous of this heterogeneous multitude.

The isolated hill which appears on the map on the north-east corner of the city, commands a fine view of the surrounding country. It was certainly the most wonderful I have ever witnessed.

Below is the square city, with its interminable suburbs spread out like a panorama; the Shan mountains to the west, the Tsagain hills to the east, the winding of the mighty river between, with its wooded islands, its numerous quaintly-shaped boats and temple-studded banks is a sight, once seen, not easily to be forgotten.

Opposite the capital, the Tasagain hills look down upon the river at places overhanging the stream, and again recede to a distance of several hundred yards from the water's edge. They contain quantities of valuable marble, and continue to follow the course of the river northward, for a distance of about fifteen miles, when they die away into gentle undulations.

At the foot of these hills lie the remains of the famous Mengoon Pagoda, one of the largest masses of solid masonry in the world. Here, also, is an enormous bell, said to be the largest in the world, after that of Moscow Cathedral. It is 90 tons in weight, or fourteen times as large as the great bell of St. Paul's.

The time allotted for this lecture will not permit me to enter into detail in describing this interesting country.

Proceeding northward, then, we leave on our right the fertile district of Madara, whence much of the fruit and vegetables consumed in the city are obtained.

To the westward, the country is undulating and clothed in dense woods. On the east bank is a small town, Singu-myo, whence a road leads to the principal ruby mines.

The stream here becomes contracted to from 300 to 400 yards across; the banks are high, and covered with forest.

There is little or no sign of cultivation, even in the vicinity of the villages, while the numerous fishing apparatus that may be seen along both banks denote pretty clearly that the inhabitants trust to the finny tribe for subsistence.

The hills in the neighbourhood are said to contain gold, silver, and precious stones. Extensive mines lie about thirty miles to the eastward.

The lower defile cleared, the stream once more widens out, navigation becoming no easy matter in consequence of the sandbanks and low, sandy islands. The villages are poor and the absence of pagodas marked.

Tagoung and Old Pagan, now poor looking places, were once royal cities. Dr. Williams, who visited them in 1863, found the remains of the fortifications of both.

Above these places the Irrawaddy is joined by two considerable streams, the Shwe-leo and the Delain. The banks continue low and swampy till the mouth of the second defile is reached. Between the northern elbow of the river and the mouth of the defile, is the sacred island of Shwe-goo, held in great veneration by the Burmese, and positively a forest of pagodas.

The scenery throughout the second defile is exceedingly striking; precipitous mountains covered with thick forest tower over head, while below, the great river, confined to a narrow channel, hissing, boiling and forming itself into huge eddies, rushes down with resistless force. At the head of this defile the river again widens, stretching out like a large lake, and on the left bank is the town of Bamò, which brings our travels to an end.

This place, of which there is a sketch in my military report, has no appearance of ever having been a large or thriving city. It is defended by a stockade on the land side.

The confluence of the Taping with the Irrawaddy takes place a couple of miles north of the town. It was from this point that our two exploring expeditions started under Sladen and Browne.

Of the tribes who inhabit these wild regions, by far the most numerous are the Shans.

They are found from the borders of Munnipoor to the heart of Yunan, and from the valley of Assam to Bankok and Cambodia.

They are a quiet, dirty, and inoffensive people. The Kakhens inhabit the lofty mountains to the north and north-west. They are said to be a wild and savage people.

The Poloungs dwell in the mountains north east of Bamò.

Most of these tribes, according to Dr. Clement Williams, acknowledge in theory the Burmese suzerainty.

Beyond the Burmese frontier on the east are the Panthays, a tribe of Mahomedan Chinese. They are a brave and enterprising people, and for years maintained their independence against the Chinese, but have lately succumbed.

Throughout the whole of Burmah, from Rangoon to Bamò, there is scarcely a village without its little Chinese portion. Situate generally in the middle of the town, the clean and smart appearance of the Chinese dwelling is remarkable. They monopolise most of the trade of the country, ever working with unflagging industry. They are in reality hostile to Europeans, though not openly so.

I feel sure, Gentlemen, you will agree with me that a lecture of this nature would be incomplete without some account of the history, character, and customs of the people who inhabit this strange and interesting land, particularly as regards their connection with Great Britain in two protracted and bloody campaigns.

The early history of Burmah, in common with that of all Asiatic nations, is, for the most part, obscure, while the veracity of that which does exist is of a questionable nature. Unaccustomed to keep regular records except, perhaps, of some remarkably stirring events chronicled on the bark of trees or cut in stone, and given by nature to monstrous exaggeration, the inhabitants can give little reliable information regard-

ing their country or their people previous to association with western nations. The celebrated traveller, Marco Polo of Venice, whose travels Colonel Yule has lately given to the world, seems to have been the first European who visited these shores, about the year 1272; but it was not until the beginning of the sixteenth century that Europeans attempted to establish trade relations with the Burmese.

At this period the country was divided into many principalities. There were kings of Arakan, Pegu, Thounghou, and Tenasserim. These monarchs generally took it in turn to desolate the neighbouring states, and to slaughter and carry off all on whom they could lay hands.

One Boves, a Jesuit, writing in 1600, speaks of the result of one of these internecine contests in the following language:—"It is a "lamentable spectacle to see the banks of the rivers set with infinite "fruit-bearing trees, now overwhelmed with the ruins of gilded "temples and noble edifices, the ways and fields full of the skulls and "bones of wretched Peguans, killed or famished and cast into the "river in such numbers that the multitude of the carcases prohibited "the way and passage of many ships."

Portuguese adventurers from time to time mixed themselves up in these quarrels; and, in the beginning of the seventeenth century, we hear of one, Philip de Brito, being proclaimed king of Pegu. He was attacked by the king of Ava however, defeated and taken prisoner to the capital, where he was impaled and set up in a conspicuous place.

According to Colonel Yule, to whom I am indebted for this information, "the dominance of Ava over the lesser states commenced from "this time." She was everywhere successful in war, and extended her dominions in all directions, conquering Pegu, Tenasserim, and Arakan, and occupying the Shan, city of Zimmé. So important a state had she become that the East India Company, which was formed in 1599, sent agents to several of the large towns on the Irrawaddy. On occasions of royal whim or displeasure, these gentlemen were ignominiously expelled, and occasionally did not succeed in getting off so easily. But at this time the servants of the Honourable Company were a very humble people, their sole object being to accumulate wealth.

In 1695, we hear of Nathaniel Higginson, governor of Fort St. George, addressing a letter to the king of Ava, couched in the following terms:—

"To His Imperial Majesty who blesseth the noble city of Ava with "his presence, emperor of emperors, and exceeding the kings of the "East and the West in glory and honour, the clear firmament of virtue, "the fountain of justice, the protection of wisdom, the lord of charity, "the protector of the distressed, the first mover in the sphere of "greatness, president in council, victorious in war, who feareth none "and is feared by all, centre of the treasures of the earth and of the "sea, lord proprietor of gold and silver, rubies, amber, and all precious "jewels, favoured by heaven and honoured by men, whose brightness "shines through the world as the light of the sun, and whose great "name will be preserved in perpetual memory." This was followed by a request to be allowed to carry on trade unmolested, the envoys

being instructed to get as much out of the king as they could in the way of presents, and to "ask for more."

In 1757 the company induced king Alompra, who had turned out the ruling dynasty and usurped the throne of Ava, to sign a treaty ceding to them the Island of Migrais, at the mouth of the Irrawaddy in perpetuity.

But in the following year, the King becoming impatient at their intrigues, ordered the whole of the foreign residents on the island to be murdered, which brutal order was carried into effect on October 5, 1759.

At this time the victories of Clive in India gave the Company a confidence which they had not hitherto possessed; and they deputed an envoy of Ava to demand satisfaction for this outrage. But he found the city in a case of tumult; the king having died there was a fight going on for the vacant throne. Alompra's son succeeded, after a tough struggle, in establishing himself in power.

He was an able statesman and daring warrior, and under him the kingdom of Ava reached the zenith of her power.

In 1794 Captain Symes was deputed to Ava to appeal against Burmese encroachments on our Chittagong frontier. The King refused to admit him into his presence. Then followed several other missions from the Governor-General to his Majesty: some were decently received, while others were ignominiously expelled. In the meantime the attacks on our frontier became more frequent; and, in 1824, the Government of India declared war against the Burmese Empire.

The plan of the campaign was this: A strong defensive force was to be extended along our frontier from Chittagong to the Burrampoota at Goalpara.

That a second army, being assembled at Chittagong, was to proceed down the coast to the attack of Arakan.

That a grand army and fleet should be conveyed to Rangoon, and advance up the Irrawaddy to the gates of Ava.

This was the general idea. We shall see how it was carried out.

Operations of the First Army.—It was divided into three divisions, the left at Goalpara about 3,000 strong, the centre at Silhet 3,000, the right at Chittagong 2,000. The left column advanced up the Burrampoota early in March, and invaded Assam; but on the commencement of the rains, in April, it was obliged to retreat with the loss of its commander, Colonel McMorine, who had died of cholera.

In the following October this force again took the field under Colonel Richards, and succeeded in its object, viz., the capture of the city of Rungpoor.

The Silhet column had for its object the capture of Munnipoor. The first attempt failed in consequence of the rains; and the second made in the following October was not more successful. The difficulties of passing men and guns through impenetrable jungles and over deep creeks were insurmountable, and Brigadier Shuldham was obliged to abandon his project and break up his army, which had been increased to 7,000 men.

That General Shuldham's army was unnecessarily large is proved by

the fact that when the advance to Munnipoor was checked, the Raja, who had been aiding us to recover his lost dominions, assembled some 500 raw levies, armed by the British Government, advanced to Munnipoor, captured his ancestral city and drove off the Burmese. In the meantime the Chittagong column had met with a great disaster, the advance party being attacked, driven back, and all the Officers, except two who were wounded, killed. The column retreated on Chittagong, and was only saved by the arrival of reinforcements.

Operations of the Second Army or Army of Arakan.—This army consisted of 11,000 men under Brigadier General Morrison. It set out for Arakan early in January, 1828, proceeding partly by sea and partly by land. After a long and wearisome march, the land force having constantly to be transferred to the boats to cross the numerous arms of the sea and creeks, General Morrison succeeded in his object, the capture of Arakan, not, however, till after some hard fighting, and no small loss.

Operations of the Grand Army or Army of the Irrawaddy.—This was conveyed to the mouth of the Irrawaddy by a splendid fleet of British ships-of-war in May, 1824.

Sir Archibald Campbell[1] commanded, and the force consisted of 13,000 men with a plentiful supply of artillery. After nearly two years of campaigning, during which time fever and dysentery worked ravages in our ranks, Sir Archibald approached the city of Ava, and the "Lord of the White Elephant" was at last brought to his knees.

On the 24th February, 1826, the Treaty of Yandaboo was signed. By this Treaty, the king agreed to concur in a commercial treaty, to receive a British resident at Ava, to concede in perpetuity the province of Arakan, and to pay a crore of rupees. Until the payment should be made, Rangoon was to remain in the hands of the English.

Thus closed the first Burmese war.

The Burmese fought bravely throughout, considering their want of organization and of good arms.

One would have supposed that after such a lesson, the kingdom of Ava would have felt a little humbled; but the reverse was the case, for scarcely had our troops been withdrawn from the vicinity of the capital; when, as Colonel Yule tersely expresses it, "the arrogance of "the nation, with marvellous elasticity, recovered its old exorbitance."

Resident after Resident was treated with scorn and neglect by the King and his ministers, until it was found necessary to withdraw the residency to Rangoon, and six months later from the country.

King Tharawaddy, who ruled at this time, seems to have been a prince of some gallantry.

Colonel Yule writes—"In 1843, when Sir Charles Napier's cam-"paign in Sindh was first heard of at Ava, Tharawaddy remarked "that he was on the best possible terms with the British, and that if "they would send ships to Rangoon he would put 1,000 men on each

[1] The Burmese Army of the Irrawaddy was commanded by the Chief Bundoola, who was in the habit of chaining his gunners to their guns.

"to go and fight on our part in Sindh. I want nothing in return "from Queen Victoria, he said, except a small feather or some trifle." "When he made this chivalrous offer," continues the same author, "His Majesty was putting people to death every day by his own "hand."

The indignities offered to our representatives and our merchants ever since the conclusion of the first war, might at any time have served as a valid cause for the renewal of hostilities. But the truth is, our hands were full at this time. The disastrous Cabul campaign in 1842, followed by the Sikh war, which, though successful, shook our Eastern Empire to its very foundation, demanded all the men we could muster. But we only wanted time.

In 1851 the Governor-General demanded satisfaction for the repeated insults offered to our merchants. The King took temporary fright and agreed to everything that was proposed.

It was only for a month or two, however, for in January, 1852, on a mission of officers being sent by Commodore Lambert to the Governor of Rangoon, they were insulted by the menials about the Court, and informed that his Excellency was asleep and couldn't see them.

To this insult the Commodore replied by seizing the King's ship, which was lying in the river, and declaring the rivers Rangoon, Bassien, and Salween to be in a state of blockade.

Negotiations ensued. But no arrangement could be come to, the same shifting policy being adopted which had ever marked the proceedings of the Court at Ava. War was declared for a second time against the Burmese Empire.

On the 4th April a force of 6,000 men, with two brigades of artillery, under command of Major-General Godwin, C.B., was conveyed to the mouth of the Irrawaddy.

The operations of this Army may be thus sketched:—

5th April.—Capture of Martaban.

11th April.—Capture of Rangoon.

14th April.—Capture of the Shoe Dagon Pagoda.

2nd June.—Expedition to Pegu.

27th July.—Lord Dalhousie arrives at Rangoon.

1st August.—A general advance decided upon.

The Army divided into two brigades under Brigadier-General Sir J. Cheape and Brigadier-General Steel, C.B.

9th October.—Prome captured by Sir J. Cheape.

10th November.—General Godwin leads a second expedition against Pegu.

14th December.—Third expedition against Pegu.

1st January, 1853.—Proclamation of the Governor-General annexing the Province of Pegu to the British Empire in the East.

It now remained for us to expel by force all the Burmese troops who remained in the Province. This was not a difficult matter. One chief, Myat Toon, alone held out and defied our power. He had established himself in a strong position, about thirty miles inland from Henzadar, and in the end of January Captain Lock, C.B., at the

head of a small force of sailors and marines, attempted to dislodge him. This expedition was bravely but unwisely led. They lost themselves in the dense jungle, were surrounded, and their leader, Captain Lock, and most of his officers were killed. The remainder had to make a disastrous retreat through a dense forest, intersected by numerous creeks, followed and harassed by the enemy.

A month later Sir John Cheape advanced with a force of 700 men to dislodge Myat Toon. His expedition was an utter failure, and he had to return to the great river without being able to reach the robber chief.

But Sir John, a hero of Moultan and Goojerat, was not to be so easily baffled in his object. He organised another force, and early in March set out from Donabew. The difficulties he encountered were almost insurmountable. After an eight hours' march on one occasion the advance party found themselves on the identical spot from which they had started the same morning. But the British leader was determined not to retire, and his resolution was at last rewarded by success. After several days' hard marching, with cholera raging in his camp, he arrived in front of the enemy's position—a long low breastwork on the opposite side of a deep ravine. The thickness of the forest prevented the steady formation of the troops, while the enemy commenced to pound them with every description of missile—rough iron and leaden balls, pieces of glass, necks of bottles, great lumps of granite, and even brass representations of their heathen gods, ejected from rusty old cannon jinjals (guns throwing two ounce bullets), and hollowed out palmyra trees bound round with iron. But British courage was once more triumphant. Storming parties, consisting of the 18th Royal Irish and 80th Regiments, were formed, and clambering over the stockades, drove out the Burmese at the point of the bayonet. These storming parties were led by Lieutenant Taylor and Ensign Garnet Wolseley respectively. Both were severely wounded, the former dying a few days later; but the latter has lived to take part in many more fierce and bloody contests, and to be an honour and an ornament to the British Army.

This may be said to have been the last episode of any importance in the war. A land column under General Steel had penetrated the country from Martaban to Tounghou. They met with no opposition, the place being reached after a thirty days' march.

Thus ended the second Burmese war, but no formal treaty of peace was signed.

Lord Dalhousie once more arrived in Burmah and fixed the position of the two white pillars which mark the boundary of British territory on the banks of the great river.

Remarks on the Campaign.

It will be seen from the above narrative that the Burmese trust entirely to their improvised fortifications for defence; and that even the consciousness of the possession of a vast superiority in numbers will not induce them to quit these rough defences for the open.

Living in a country covered with forest they are highly skilled in woodcraft, and the rapidity with which they can erect stockades and form impenetrable entanglements in the jungle is astounding.

As to the methods of attacking them in their strongholds, the experience of this and the first war teaches us that assault was by far the most effective; but in these days of improved artillery they could certainly be "routed out" without having to resort to such an expensive mode of attack.

Notwithstanding that the campaign lasted nearly a year, the opposition offered to our arms was not at any time formidable, and there is little doubt that had we advanced straight on the capital early in August, the war would have been quickly brought to a close.

Individually the Burmese are not cowards, and if well led are good soldiers. They are much given to panic, however, which is attributable to the utter incapacity of their chiefs.

In hardihood and power of undergoing hunger and fatigue, they are certainly equal to any people under the sun. The "field kit" of a Burmese soldier consists of a mat to sleep on, carried at the end of his musket, a cooking pot slung over the other, round his loins is found his wallet of rice, which added to the *dah*, or chopper, inseparable from every Burman, completes his outfit for a campaign. When such luxuries are not obtainable, however, these sturdy little fellows can keep themselves alive and in working condition for months on leaves, herbs, and the bark of certain trees.

Throughout this whole war, the untrustworthiness of the Burmese guides seems to be apparent, and points to the necessity of the utmost caution in the event of a future campaign in Burmah.

In the summer of 1855, Major Phayre, the Commissioner of Pegu, was deputed to Amarapoora, now the capital of Burmah proper, to negociate a commercial treaty.

He was accompanied by a suitable escort of European troops, and was well received by the King. The story of this mission has been ably told by Colonel Henry Yule, and is both instructive and amusing.

Neither trouble nor expense had been spared to display to advantage the power and wealth of the kingdom. Every available citizen and country bumpkin had been rigged up in a grotesque dress and converted into "a warrior bold," while the valuables, in the possession of which the Burmese prided themselves, were everywhere displayed under the noses of the visitors.

After considerable delay, His Majesty fixed a day for his grand reception, and the party adhering cheerfully to the absurd formalities of the court, removed their shoes and squatted half kneeling, half sitting at the foot of the throne.

The King made a few general remarks about the Crimean war and the topics of the day, and then dismissed the English officers. Several other receptions were given after this, but the King talked of every subject but that of the treaty; on the necessity of the strict observance of the ten virtues—charity, religious observances, self-denial, learning, diligence, patience, truth, perseverance, friendship, impar-

tiality, but on the subject of the treaty he was dumb. "The two great powers were on friendly terms," he said, "and what was the use of a treaty."

Major Phayre urged the necessity of some written agreement, but in vain; and at length wearied and disgusted, he returned to Rangoon with the object of the mission unfulfilled.

For the next two years no important events occurred; while British Burmah thrived under the vigorous administration of Colonel Phayre.

In 1858 the King moved the seat of Government from Amarapoora to Mandalay, the present capital. At the end of 1867, Colonel Phayre was succeeded by Colonel Fytche, who at once turned his attention to the long-sought for commercial treaty. His courage and firmness were rewarded and the treaty signed.

Colonel Fytche next despatched Captain Sladen, the political agent at Mandalay, to explore the trade route through Burmah to Western China.

The expedition started from Bamò with the avowed good will of the Burmese Government, the objective point being Talifoo, the capital of Yunan. They were thwarted at every step, however, and eventually obliged to return, having only reached Momien, half way to Talifoo. There is little room for doubt that the Burmese authorities at Bamò had secret instructions to use every means in their power to defeat the object of this expedition. This was the opinion of Captain Sladen and his party,

I have now brought you down to our own time. The expedition to this same country under the leadership of Colonel Horace Browne, its disastrous failure, the murder of Mr. Margary, and the retreat of the party surrounded and pursued by enemies, was but the other day a common topic of conversation, and is not cleared up yet. With this I close the historical portion of my lecture, and will now make a few remarks on the Burmese system of Government, military organisation, &c., &c.

The monarch has absolute power of life or death; and can confiscate property without trial or investigation—a privilege of which he invariably avails himself if he has reason to believe that any of his subjects are becoming too rich.

The affairs of the State are principally conducted by a council of four Woonghis, or Ministers of State. These constitute what is called the Hlwot Dau, or High Court and Council of the Monarchy. Next in importance to the above gentlemen are the Atwen Woons, or Ministers of the Interior, whose duty it is to look to the private wants of His Majesty and to convey his orders to the Supreme Council.

For the sake of local government and collection of revenues, the country is divided into myos or districts. Over each district is placed a governor or Myo-oke, who appoints his own subordinates over towns and villages. The revenue is obtained from several sources. The house or family tax, each district being taxed according to the number of houses it contains. From this tax there are many exemptions, such as being in the Government service, &c.

Agriculture is taxed according to its value, and is almost invariably paid in kind; there is no regular tariff, however, the amount varying in different districts, and depending often on the wealth of the payer. Rice, pepper, onions, tobacco, palmyra trees, yielding juice for sugar, salt, and other articles for daily consumption, together with bullocks for ploughing, and sometimes fisheries are taxed.

In 1855 the revenue of the kingdom amounted to £400,000, and is probably about that amount to-day. There is no such thing as progress with the Burmese. "What is, is good" is their motto.

The army is raised and organised for war rigidly on the local system. Each district has to furnish a contingent strong in proportion to its inhabitants. Each corps of 500 men is commanded by a Boghi, or commandant, who has under him captains of hundreds and captains of fifties. Little attempt is made to train these forces during peace, the officers being entirely ignorant of their duties.

Districts are held responsible for the supply and arming of their own contingents, but the system of doing so varies in different districts. The governors of districts obtain their soldiers by conscription, and substitutes are allowed on the payment of money. The subordinate officers are paid by having a certain portion of rice and money levied on the people allotted for their subsistence. The commandant pays himself by levying a tax on his own officers and men.

From the above description then, it will appear that the strength of the Burmese Army must depend on the population, and its efficiency on the amount of arms and ammunition in the country.

Considering the area of the kingdom the population is wonderfully small, amounting to only 3,000,000 souls. The arms now in possession are few and of a wretched description. The British Government does not allow the King to import arms.

The naval resources of the kingdom may be estimated at *nil.*

Education to a small extent is universal among the Burmese, every child being taught to read and write by the Phoonghis or Buddist priests who swarm in every town in the country.

They subsist by voluntary contributions, and are known by their yellow garments.

In religion the Burmese, in common with all the Indo-Chinese nations, are Buddists.

They do not believe in the existence of a God in the sense of our faith, but in reward and punishment in an infinite succession of existences varying in duration from the span of insect or animal life to incalculable periods. In this faith live 369,000,000 of souls.

The character of the Burmese has been sketched with photographic truth by Major Allen in the following words—

"Unlike the generality of Asiatics, the Burmese are not a fawning "race. They are cheerful and singularly alive to the ridiculous, buoyant, "elastic, soon recovering from domestic or personal disaster. With little "feeling of patriotism, they are still attached to their homes, greatly so "to their families.

"Free from prejudices of caste or creed they readily fraternise with "strangers, and at all times frankly yield to the superiority of the

"Europeans. Though ignorant, they are, where no mental exertion is "required, inquisitive, and, to a certain extent, eager for information; "indifferent to shedding blood on the part of their rulers, yet not individually cruel. Temperate, abstemious, and hardy, but idle with "neither fixedness of purpose nor perseverance.

"Discipline or any continued employment becomes irksome to them, "yet they are not devoid of a certain degree of enterprise.

"Great dabblers in small mercantile ventures, they are (the women "especially) a race of hucksters, not treacherous or habitual perverters "of the truth, yet credulous and given to monstrous exaggeration; "where vested with authority, arrogant and boastful; if unchecked, "corrupt, oppressive, and arbitrary, not distinguished for bravery, while "their chiefs are notorious for cowardice, for with the latter cunning in "war ranks before courage. Inexpert in the use, and careless in the "preservation of their arms, they are indifferent shots, and, though "living in a country covered with forest, are not bold followers of field "sports."

I cannot bring this lecture to a close without making a few suggestions and proposals on our best mode of procedure, should the present negotiations at Mandalay terminate in a third Burmese war.

In the event of this, I conceive that the "theatre of war" would be almost exclusively confined to the valley of the Irrawaddy from our frontier to the Burmese capital; for on this portion of the Great River are situated the richest and most important towns in the kingdom, while inland the country is thinly populated, is covered for the most part with thick jungle, and intersected by a network of rivers and creeks.

The object of operations ought certainly to be the occupation and destruction of the capital.

Its fall would completely paralyse the kingdom and reduce further resistance to a minimum, for within its walls are almost all the stores and valuables of the king; and, furthermore, his only truly loyal subjects are the Burmese who reside in Mandalay and its vicinity.

The frontier of British Burmah is, at present, defended by the fortresses of Thayetmyo on the Irrawaddy, and Thoughon on the Sitang.

Each is garrisoned by a wing of an European regiment and one native infantry regiment and a battery of field artillery. Since the annexation of Pegu, in 1852, no communication has existed between these two posts, but a road is now under construction, and is so far finished that, some few months ago, Colonel Jebb, 67th Regiment, marched a detachment from Thayetmyo to Thoughon in nine days, no man suffering.

Elephants are necessary, the road not being practicable for carts.

It takes five days by steamer to reach Thayetmyo from Rangoon, and seventeen days at least to reach Thounghou by country boats from the same city. The distance between the posts is about 120 miles.

Troops are conveyed up the Irrawaddy on flats towed by small

steamers. Each flat will accommodate about 250 soldiers or a battery of field artillery. In case of war, conveyance for a force of 5,000 would be obtainable.

In the dry weather—November till April—troops can be marched from Rangoon to Thounghou by land. There is also a practicable road from Rangoon to Prome which is only some 25 miles from our frontier. I think that a force having for its object the conquest of Upper Burmah should be formed into two corps; one the army of the Irrawaddy, the other the army of the Sitang. The first-named corps should consist of about 5,000 men with a plentiful supply of light guns, and should proceed up the river on flats and river steamers early in August when the navigation is easiest, to the direct attack of the capital. A few of the most important towns might be shelled, but it would not be necessary to waste time in their capture or occupation.

The land column or "Army of the Sitang" might be similarly composed, and march with the same object in view, later in the year after the capital had been occupied by the first army. They would require to be well provided with materials for crossing the numerous creeks by which the pathway—for on Burmese authority one does exist—from Thounghou to Mandalay is interrupted.

And now, Gentlemen, I believe I have exhausted my subject. I have traced on the map the geographical features of this interesting country. I have given you my own personal experiences and observations. I have related in a compendious form the history of Burmah from ancient to modern times, touching somewhat hurriedly on our later relations with the Burmese King—his duplicity, his cunning, his utter disregard of truth or honesty; and I will leave you to speculate for yourselves on the probabilities of his having thwarted the two attempts made by the Government of India to open up a trade with Western China.

Notwithstanding his many shortcomings, however, the King of Burmah has a perfect right to govern his country independently of Great Britain; but it is the duty of the latter, as mistress of civilization in the East, to demand, and, if necessary, enforce his co-operation in great schemes for the furtherance of trade, of progress, and of enlightenment.

LECTURE.

Friday, July 2nd, 1875,

Admiral SIR HENRY J. CODRINGTON, K.C.B., in the Chair.

SEAMEN OF THE FLEET, THEIR TRAINING, AND HOW THE EMPLOYMENT OF MARINES AFLOAT IN PEACE TIME AFFECTS THEM.

By Captain J. C. WILSON, R.N.

BEFORE entering fully on the subject of this paper, it may be well to remind my hearers that prior to the Russian war all the seamen of the Fleet were entered only for a ship's commission, their term of service ending when the ship paid off. In consequence of the difficulty found in manning our ships at the beginning of and during the war, Government in 1854 determined on introducing what is now termed the "continuous service" system, by which men are engaged to serve for ten years from entry, or from the age of 18.

To provide men it was also found necessary to train boys, as merchant ships had, in a great measure, ceased to carry apprentices, and the supply from that source could no longer be relied on. The growth of the training service has been gradual, and it is only during the last five or six years that the Navy has been entirely dependent on it to make good the annual deficiency of men in the Fleet.

Our seamen, therefore, are no longer birds of passage, migrating from the Royal to the Merchant Navy, sometimes serving under the English, at others under the American Flag, but a carefully picked and expensively reared body of men, a standing force, which must be kept up to a certain numerical standard, regulated, not by the immediate requirements of the Navy, but by the policy of the country. It is consequently obvious that with the establishment of such a permanent force, the conditions of service became totally changed; and, to meet such an altered state of affairs, other radical changes were, and still are, necessary to make the whole system work harmoniously and efficiently. To begin with the boys; there are five stationary training ships under commanders, with an "Inspecting

Captain," who has the general supervision of the whole. In these vessels three thousand youths are supposed to be trained annually, but as the supply has never yet equalled the demand, the number has hitherto been from two to three hundred short of the vote. The boys, if their parents consent, are taken at from 15 to 16½ years of age, after having undergone a most stringent physical examination. These requirements being satisfied, if they can read, write, and cypher fairly, and have never been committed by a magistrate, they are allowed to engage for ten years from the age of 18. On completing one year's training, and, after passing an examination, they are rated "1st class "boys," when a certain proportion are put through an advanced course of gunnery, either in the "Boscawen," or in the gunnery ships, and about one-half of them are also sent on a six weeks' cruize in one of the five training brigs. A rôster is kept on board the "Inspecting Captain's" ship; and, as far as circumstances will admit, they are drafted in rotation by him. Taking one with another, boys are two years from entry until rated as men, or, in other words, their average age on entry is 16; and, taken throughout, they have about two months' sea service in the fleet as boys. Though our sea going ships carry as many boys as they can stow, there are still from 1,500 to 1,700 constantly on depôt, waiting their turn for draft. This delay is much to be regretted, and can only be avoided by keeping sufficient training ships at sea to provide for that proportion of boys (about 1,400) which are due to the men kept in our home ports. Whilst thus waiting, a considerable number of them reach their 18th year, and are by order rated men, thus the 1,200 ordinary second-class, may be taken to represent a body of sailors, who have never been at sea at all!

As to the quality of the boys, I found but little difference between those drawn from town or country, both have their advantages, but there is no doubt that the younger they are taken the better sailors they make; and, what is more, though they may be more costly at first, they are, on the whole, the least expensive, as they become more identified with the profession, and consequently less likely to desert.

The training of boys has been encouraged by successive Boards of Admiralty, but by none more so than the late board whilst presided over by Mr. Goschen. Under his auspices, and the able administration of Sir W. Tarleton and of his predecessor, Captain (now Admiral) Willes, many very important improvements were introduced, such as provision for a proper outfit for the lads before being sent to the Fleet, a liberal scale of dietary, suitable to healthy growing boys, with a regular system of drafting them in turn. Under the present Government, they have been granted the still greater boon of a free kit on entry, value *5l.*, which enables them now to remit home a large portion of their pay from the very first.

Taking the average of the three years from 1871–1874 (and all the figures I shall quote apply to this period) I find the seamen in the fleet, or what are called in Parliament, "*pure blue jackets*," numbered 18,683; of these 18,050 were C. S. men. The number is made up as follows, P.O., 3,942, L.S., 1162, A.B, 7,153, ordinaries 5,206, and

ordinary 2nd class, 1,210. The waste on these varies from 11·5, to 14·0 p. c. per annum, and on the above, amounted to 2,504, excluding re-entries.

To replace the waste 2,727 men were rated from boys, or entered, 2,400 from boys trained in the training ships, 204 from first class boys (or novices), raised and instructed in the coast guard ships, and 123 men entered probably as second class ordinaries in the coast guard, or receiving ships. The lads entered as first class boys in coast guard ships are, in my opinion, very inferior to the others, they are usually but little under eighteen when entered, and speaking from personal observation, I would say are generally older than they represent themselves to be, and if so, of inferior *physique*.

The bulk of the waste arises from three causes, first, death and invaliding; secondly, discharges; thirdly, desertion.

The first is unavoidable, the second includes men pensioned (328), those sent to coast guard (221), and 175 ten-years' men, third, deserters numbering no less than 709. With such a drain on the service from desertion (which for 1873–74 was 835, and I have good reason to believe is nearer 1,000 for 1874–75 than 800), it is a matter of importance that its cause should be ascertained, and some means devised of stopping, or at any rate checking it. The loss of seven or eight hundred men per annum, at first sight, appears but a small affair, but when it is remembered that each of these deserters has had regularly to be manufactured from the raw material into a seaman, and that on an average each one of them has cost the country from three to four hundred pounds, it will be seen what an enormous expense desertion entails, probably not less than from £200,000 to £300,000 per annum.

Nor does the mischief end there, desertion is the principal reason why our seamen, as a body, are so dangerously young, and so wanting in experience; the deserters absorb for no useful purpose, a large proportion of our instructing power, and render it next to impossible for the boys, and young seamen, to obtain the sea-service necessary to fit them for higher rates, and their work. The cause of desertion lies probably more in the nature of the man, than in the profession; restless, high spirited, and healthy, with no experience of the world, he pines for change, and does not discover until too late that labour out of the service has quite as many drawbacks as in it. To meet the case, I would introduce a more elastic system, combined with time pay, by which a man could, with reasonable facility, obtain his discharge from the Commander-in-Chief of the station, or under certain circumstances, from his own Captain.

Every five years I would increase each man's pay by 2*d.* a day (£3 a year) whatever his rating might be, so long as it was not below that of A.B. To do this some £60,000 a year would be added to the Estimates, but if it only reduced desertion by one-half, the country would be largely the gainer, not only in a pecuniary sense, but also in the increased efficiency of the service. At first a considerable number of men might be expected to apply for their discharges, but after a time, many would return to their old calling, and settle down steadily

to their work. If a man really wishes to go he can always manage to do so, the *punishment* for desertion only prevents him *returning*, not leaving. Considering how young we engage our boys, and the time we bind them to the service, it is no less just than expedient, to allow them an opportunity of gaining their freedom on fair terms, and with reasonable facility.

Much has been said and written about the loss of "ten years" men, but the fact is, our loss numerically is small, being probably not more than from 18 to 20 per cent. of those who annually complete their first period of service, or about 175 in all. Still 175 "ten years'" men, small as the number looks, represents the equivalent of one year's entry of boys in, say, the "Ganges," for, as for every three boys enrolled we have only one man at the end of ten years, allowing for waste, the loss of 175 ten years' men necessitates the entry of about 525 boys. These men, few in number, but admirable in quality, are now totally lost to the service, but if allowed to take as a retainer, the time pay proposed above, and not required too frequently to requalify, they would no doubt be glad to enroll themselves as a reserve, always available, and composed of the very best material.

The crews of men of war are made up of two classes of men, viz., combatants, and non-combatants, the former consist of seamen, and marines, and their officers, the latter, of civilian officers, stokers, artificers, cooks and stewards, &c. The proportion of non-combatants is, in ships of the following type.—

"Sultan"	.. ..	30 per cent.
"Devastation"	.. ..	50 ,,
"Hotspur"	.. ..	58 ,,

In vessels corresponding to these, of some years back, the proportion was, in the—

"Royal Albert"	..	10 per cent.
"Immortalité"	..	20 ,,
"Zebra"	.. .. ..	30 ,,

It is, therefore, clear that the tendency is for the fighting element to decrease in the newer vessels. This, in my opinion, is a most dangerous fact, for though a ship thus manned may be efficient for fleet purposes, it must render her less so for the numerous other contingencies certain to arise in time of war, and such a preponderance of undrilled, and very imperfectly disciplined men, is at all times, but especially in an emergency, a cause of weakness which may lead to failure, if not disaster. Without barracks, where such men, like the sappers and miners, could be regularly disciplined and trained, I fear this sad blot on our naval system must remain.

The combatants consist of seamen and marines, but I will at first confine myself to the former. It will be seen from figures I have already given, that we have but 12,000 able bodied men; which is surely as low a number as the most rigid economist would dare to advocate for the "first naval power of Europe." I contend that they, and they alone, are the proper class to estimate the *seamen* power of our fleet by; the custom of speaking of our men as "pure

blue jackets" in Parliament, is misleading, for all naval men know how any one, from a cab-driver to a crossing-sweeper, may be included under that designation, whereas for a man to be rated an A.B., he must be a sailor of some experience, and knowledge of his profession. However good and useful ordinary seamen may be, they are at best but learners, and should, therefore, always be as much distinguished from the finished sailor, as boys are from them.

I will now proceed to analyse the services of our seamen. The fleet consists of sea-going, and harbour ships, which may be roughly divided as follows:—

Regular men-of-war from sloops to ironclads..	72
Small class gunboats, yachts, tugs, brigs, and surveying vessels	82
Turret ships	1
Troop and store ships	16
Stationary and coast-guard ships	49

In sea-going vessels we have only 10,500 blue jackets of man's rate, the remaining 8,000, are in the harbour ships. Such being the ordinary state of the service, it follows, that our men cannot have more than eleven and a-half years at sea, such as it is, out of their twenty. Dividing the twenty years into four periods of five each, I find the standing of our men to be, 10,000 of under five years' service, with an average of eighteen months at sea and twenty and a-half years of age; 4,270 of between five and ten years' service, with an average of four and a-half years' at sea; 2,603 of from ten to fifteen years' service, and seven and a-half years' at sea; and 1,816 of between fifteen and twenty years' service, and ten and a-half years' at sea. This calculation is based on the supposition that each man has exactly the same amount of sea service, which is practically not the case. A curious fact will be observed from the above figures, viz., that our P.O.'s[1] and L.S. combined, exceed in number the whole of the men in their second period (of ten years') service, and that the P.O.'s alone, are, as nearly as possible, one-third of our able-bodied men. Such being the case, is it surprising that many of the P.O.'s are inexperienced and of doubtful character.

During the time men are in reserve at the home ports, they have no systematic instruction, either in drills, or seamanship; indeed masts and sails are not even provided, boating also is entirely neglected, nor is there room in the receiving ships, even had they the staff, to instruct men properly. With naval barracks, all this loss of valuable time would be avoided, men could be examined on their return from sea, and rubbed up where found deficient. If at first it was thought too expensive to attach to such establishments rigged vessels to exercise in, the men could still have gymnastic instruction, which, by developing

[1] A.B. stands for Able-bodied.
P.O. „ Petty officer.
L.S. „ Leading seaman.
T.M. „ Trained man, or men.

their muscular powers, would, at any rate, fit them in some measure for the work they have to perform at sea.

However well our seamen may be instructed in gunnery in the regular men-of-war, and in the gunnery establishments, the system elsewhere prevailing at home, is, in this respect, most imperfect, neither room, staff, or other essentials being provided, consequently drills are carried on in a very slipshod manner, doing the men more harm than good, as slack drill, where attention is not enforced, is extremely detrimental, and does more to "un-discipline" men than anything else which could be well devised. Here again the want of barracks is sadly felt, in them the seamen could be qualified properly in all their drills in half the time, and much more thoroughly, than when afloat, and with that exactitude which is so very essential to perfection, and which is the backbone of *real* discipline.

At present there is no guarantee, that after all the care, trouble, and expense now bestowed in training our men, they will have a weapon in their hands, or pass a day's drill, from the time they leave the training ships, until they are pensioned out of the service, for it is quite possible that a man may spend the whole of his time in troop, store, or receiving ships, and at the end of his career be as ignorant of his drills as a ploughboy.

Of the 18,683 men now in the fleet, 3,230 are seaman gunners, and 6,462 T.M., leaving 8,889 not classed as either. Considering that they all belong to a standing navy, mainly reared from boys, this is, I submit, hardly satisfactory, especially to those who know how imperfect most of the men noted as T.M. are in many of their drills.

Were the men systematically qualified during the time they are in reserve, our standing force of seamen, however deficient they might be as *sailors*, could at any rate be relied on in time of war as trained fighting men to leaven the scratch crews with whom they are sure to be mixed, and be able to fill the more important duties at the guns; but if not better instructed than at present, they will be found far too imperfect themselves to help others, though sufficiently so to form, as it were, the "dunnage," to fill in round better men in our peace establishment.

Keeping as we do a very limited number of ships in commission, and seeing how little sea work we are at present able to give our seamen, it becomes a matter of the first importance to consider whether, in *peace time*, marines should be embarked in *sea-going vessels*.

I at once grant, that if the country is prepared to keep enough ships going to employ our seamen and marines, it would be best for both classes of men to be embarked, so that they might be accustomed to work together in peace, as they would have to do in war. But as we well know, this is not done, and never will be done, it is simply a question whether the seaman, or the marine, deteriorates most by remaining in reserve. It is sometimes argued, that if the marines are not embarked in time of peace, they will become nothing more or less than soldiers, and that regiments of infantry would be as useful at sea in time of war; this I deny. In the first

place, a marine enlists to serve afloat, as well as on shore, but besides, his training is very different to, and much more elaborate, than that of a mere soldier, as in addition to learning a soldier's duties, he is taught ship gun drill, how to swim, pull a boat, work in rope, and other valuable matters, which fit him for his position on board from the moment he steps over the gangway. Indeed, a marine may be said to receive no instruction on board ship, beyond what is necessary to enable him to work efficiently with the other men at his gun; his training in fact is completed on shore, and he is requalified in all his drills, each time he disembarks. Thus, a marine loses nothing of his proficiency as a *fighting man* by remaining in barracks, and it is a question whether the experience he gains of ship life by sleeping in a hammock, and the art of keeping himself awake for a four hours' watch, when sentry in a stuffy cockpit, is of equal value to what he loses in other ways. In our sea-going squadrons we have at present in round numbers 4,000 marines, who, if landed, would make room for nearly one-half of our young seamen, now rusting in harbour ships without any adequate professional instruction, either in seamanship or gunnery. Surely, when there is not room for all, the *sailor* should have the preference, he must, under the most favourable conditions, deteriorate more than the marine, and we know that proper provision is made to instruct the one, at such times, and not the other. In peace time, the marines should garrison our principal naval ports, under the command of their own general officers; such appears to be their birthright, and would probably be so regarded in any other country but England. Detachments, in proportion to the size of the squadrons, might be kept at the naval head-quarters of each station, under field Officers, ready to march on board at the first sound of war, displacing a like number of seamen, who again, with more marines, could man any reserve ships kept on the stations, or be sent home for disposal. Thus the marines would become the *expanding medium* of our Navy, and be embarked only when from the introduction of naval reserve men, and other half-raw material; their presence would be the most valuable, adding, as it would, solidity and discipline to the crews, and rendering the ships more thoroughly efficient as fighting ships.

The word discipline is only partly understood in the Navy, and is often mis-used; *good conduct* is too often mistaken for real discipline, such I take it, is but one feature of its meaning, for men may be very indifferent characters, and still be kept under admirable discipline. Thus we sometimes hear the marines compared unfavourably with the blue-jackets, if the former happen to commit more faults than the latter, and the discipline of the seamen consequently extolled; but the fact is, that by training from boyhood, the seamen class has improved in *respectability*, and from being early removed from contaminating influences, their average *character* is better, and possibly now superior in some ships to that of the marines; but I deny, I own with regret, but still emphatically, that the discipline of our seamen is superior, or even equal, to that of the marines; nor can it ever be so until we have barracks for them on shore. True discipline can only be

arrived at by attention to innumerable small details, and by a punctual, and exact routine, which afloat, the exigencies of ship life do not allow of. It should be a branch of a young Officer's instruction how to deal with men, so as to render them willingly amenable to discipline. Education now-a-days makes it daily more necessary that they should be treated with proper consideration, and thoughtfulness; the grades of society run so much one into another, that it is difficult to draw the line between classes; and I know, from personal experience, that it is now not uncommon to find as blue blood under the seaman's serge frock as under the Officer's uniform coat.

I have herein briefly sketched out the present position of our seamen, in the hope that a question so vital and interesting may be freely discussed. I have ventured to advance opinions in which I know many of my brother Officers will not agree, but the arguments brought forward against them will, whether convincing or not, at any rate be instructive. It must not be supposed, because I have pointed out some of our shortcomings, that I do not recognize the vast improvement which has of late years taken place amongst our seamen; they are undoubtedly superior as men of warsmen to a like number taken from the Fleet twenty years ago; but, considering that we rear them from boyhood, they still fall far short of the standard we have a right to expect, and are inferior in discipline and training to the French, if not the Russians. The fault does not lie with the Officers, but in the organization which is extremely defective, and must be entirely altered before the results can be satisfactory. With England's resources the *material* of the Navy can never be so difficult to provide as the trained seamen. The smaller the number, the more reason is there why these men should be as perfect as possible, so that in war they may be *potent* enough to leaven the mass of half, or wholly untrained material, with which they must be mixed.

All countries are looking to their navies: France, even now, after all her misfortunes, employs 22,000 *seamen* in her Fleet, with a reserve of 80,000, not including 20,600 marines. Russia has 20,000 *seamen* in her Fleet, with 40,000 in reserve; and even Germany, a power which, twenty years ago, could not man a small frigate, has 4,370 *seamen* and 300 boys afloat. These facts speak for themselves. We must not forget the lesson taught us by the late American War, how in a few months the *personnel* of their Navy was expanded from 5,000 to 60,000. If our trade is not to be driven to seek shelter under neutral flags, we must be prepared with ships to cover the ocean, each vessel of the enemy's will require six of ours to watch her, such vessels must have a large proportion of seamen in them, and unless their crews are good they will find themselves at a disadvantage, for no enemy's cruizer will be sent out against our trade, without a large, and thoroughly efficient ship's company. "Once let us forfeit our naval supremacy, and "we could not retain, even for a few years, our mercantile and maritime "pre-eminence. Therefore that policy is most advisable which secures "our power of striking hard at an enemy in war, even if it expose us to "some annoyances, not exactly of a flea-bite character, in time of "peace."[1]

[1] From *Standard* of March 22, 1875.

Since writing the foregoing paper, my attention has been called to an interesting article in the "United States Naval Institute Journal," on the Manning of their Navy and Mercantile Marine, by Captain S. B. Luce, U.S.N., and from which I will quote the following paragraphs:—

"The breaking out of the Crimean War revealed two interesting "facts, till then not generally known: the splendid organization and "discipline of the French Navy, and the low state of the English "seamen. Following promptly the opening of hostilities, the French "squadron put to sea in the highest state of efficiency, and large "bodies of troops and all the various munitions of war were trans- "ported to their destination with an alacrity and order which filled "with dismay their ever-watchful neighbours across the channel, "while numbers of the finest line-of-battle ships of the English Fleet "swung to their anchors, in helpless inactivity, waiting for men. "The English, relying on their ancient prestige, had been content "to continue customs which the advanced state of naval science "had long before rendered ineffective; while the complete reorganiza- "tion of the French Navy, commenced by De Joinville, and wisely "continued by the late Emperor, brought the French Fleet up to the "state of perfection in which the war found it."

Again—

"Money can always be raised by the State, and money will produce "any number of craft; but money will not make sailors; gold will "not make a disciplined crew nor an experienced staff of Officers; "and of what use are ships without the living soul to command and "the ready hand to obey? To collect, form, and train these should "be the first solicitude of a great maritime power, as it is the most "important part of its tasks."

These opinions, coming as they do from a talented and observant Officer of the U.S. Navy, corroborate what I have attempted less clearly to express, and show, however highly some of us may esteem our own seamen, that others, equally well able to judge and who are more disinterested, consider them, at any rate, inferior to the French in organization and training as men-of-war's men.

The CHAIRMAN: Captain Wilson having concluded his interesting paper, I hope some gentlemen present will give us the benefit of their opinions on the subject.

Rear-Admiral WILLES, C.B.: I beg to thank Captain Wilson very much for his interesting and carefully drawn up paper. Even if it does no other good, it starts a discussion on a very important question. As I am limited to ten minutes, I cannot waste time even in paying compliments to the gallant lecturer. All I can say is, that bearing in mind that he is one of the Officers who, we hope, will be to the *fore*, when some of us are passed away, we cannot attach too much importance to the opinions he has expressed. Two months ago I listened for three days to an important discussion in this theatre upon recruiting the Army, when our gallant Chairman's brother was in the chair; and all I hope is, that we shall be a little less condemnatory in our opinions than the Officers of the sister Service were upon that occasion. The state of the *personnel* of the Navy, in the event of a great war, is this. The total vote of men, including Coast Guard, is 60,000, of which, Captain Wilson very truly said, the "pure blue jackets" are but 18,000. The Pensioners[1]

[1] By Parliamentary Return, July, 1875, there are 9,692 long service pensioners,

6,000 to 7,000 able men, and the Naval Reserve 17,000; but what number we should obtain when that force is first called out, is a question that might lead to discussion. I will take it at about 12,000. That gives us 75,000 men at the first outbreak of war. Looking at an old return, I find that in the year 1812, when America was our enemy as well as France, the vote of seamen and boys was 113,000, marines 31,000, making a total of 145,000. At the present time we have just half that number. In those days three or four months elapsed, and sometimes longer, from the rising of the cloud until the storm actually burst. I think, in 1870, war was declared after five days; therefore, it is certain we shall not have much time to prepare. Now how are we going to increase our force from 75,000 to 145,000 men, assuming ourselves to be at war with two maritime Powers? That is a question I hoped Captain Wilson would have started, for it is a very important one. I maintain that we have not the Mercantile Marine to fall back upon as in former days. As far as mere figures go, perhaps, we have; but the material that we want does not exist. Every movement of late years that has tended to the grandeur of England has gone against the Mercantile Marine. The abolition of the Navigation Laws, and doing away with apprentices, are two such measures. No doubt, England has prospered very much in consequence, but the sailor has deteriorated. The Suez Canal has been damaging. It has swept away the sailing traffic round the Cape of Good Hope, and the steamers themselves are chiefly manned by Lascars. This question becomes a very serious one; and as I see some of our rising Officers here, I say they must look it in the face; we must have a system by which the men may pass from the Navy into the Merchant Service, and *vice versâ*: Sir Frederick Grey, four or five years ago, wrote a pamphlet on the subject,[1] very well worth reading. Mr. Childers was also alive to this; and I sat on a Committee which was very much criticised at the time, where the deliberations pointed in the same direction, *i.e.*, the amalgamation of the Mercantile Marine with the Navy; so that, when war broke out, we could at once put our hands on a large body of trained men. Our report was considered by the Admiralty a confidential document, and therefore I cannot say anything about it. I mention this to show that the subject was not overlooked by Mr. Childers and his successor. No doubt the present system of supplying the Navy is very nearly perfect; it was perfect until the large ships were reduced and the ironclads and smaller ships became more common. The state of the case now is as Captain Wilson has said, we positively have not got enough ships to train our boys. I am sure Captain Wilson would not have quoted figures that are not correct, and therefore I repeat boldly his statement. We have 1,500 first class boys for whom we have no ships, so that we cannot keep up our full complement of 18,000 *seamen*. We must have more ships—not ironclads, not small sloops, but training frigates. Mr. Goschen determined to commence that system, and the "Aurora" was fitted out. Prejudice, I fear, did away with her, and we never got another. Mr. Goschen intended to have two such ships; they would have taken about 600 or 800 ordinary seamen or boys; very disagreeable work for the Captains and Officers, but what are we for but in peace time to train men so as to be ready in case of war.

I will now just venture to criticise one or two points of Captain Wilson's paper. First, he proposes to give facility for discharging men. Well, I do not like that, it is so difficult to get others, they are too valuable. And what is a sailor? I remember some years ago, when Sir Charles Wood was First Lord of the Admiralty, continuous service men were allowed to *take* their discharge; *it was practically discharging them*, because a sailor is a restless creature, and gladly accepts any change proposed to him, and so we lost a lot of valuable trained men, never to return. I think we should be very careful how we let our men go, and particularly troublesome

of which 4,063 under 50 years of age, 5,629 over 50 years of age. A very large proportion of the 9,692 would be available in case of war; the elderly men in fitting out ships, and replacing young men now employed on that duty.

[1] Sir F. Grey, in 1870, proposed to establish, with State aid, training ships for boys at our principal mercantile ports; the boys to be rated ordinary seamen at 18, serve one year on a ship of war, then pass into the Naval Reserve for a fixed period, thus increasing that force with efficient *trained* seamen.

characters. I know some of my brother Officers will hardly agree with me, and I think they too frequently apply to the Admiralty to get men discharged. In this way we lose a number who have been trained up from boys and have cost a great deal of money, and who thus obtain for nothing that which a good man has to purchase.[1] I have found it to be a good thing to allow seamen to *change* their ships when they are not going on satisfactorily.

Captain Wilson proposes to increase the able seaman's pay. I think he is quite right. I suggested it some time ago, and I would do it in this way: I would abolish leading seamen; we do not want them. Leading seamen were introduced for this reason: there were very often men in the Navy who were unfit for petty officers—old fellows who went about the deck and made themselves very useful, but still who had not life and activity enough for petty officers—and so the Admiralty of that day established the class of leading seamen, giving them twopence a day extra. A leading seaman is now a stepping stone to a petty officer. That was never intended; therefore I would abolish the leading seaman altogether, and give the A.B.s the twopence a day increase.

I now come to the ten years' men. Captain Wilson has done good service in drawing attention to that subject. Captains are under the impression that our ten years' men are leaving us; it is not correct. They go, but to another ship. We lose a very small proportion; but even that small proportion is a very great loss, and I suggest that the 6*d.* per diem pension, which is only in abeyance, should be given them as retainers. There is another point which Captain Wilson mentions, with which I do not agree. He rather looks down upon the ordinary seamen. I have found too many A.B.s an objection. You would have too *good* a crew if you *have* all A.Bs. It would create jealousy and ill-will about promotion. The Admiralty proportion is a wholesome one: one-third A.B.s, one-third first class ordinary, and one-third second class. That is, I think, a very satisfactory proportion. The young man of 19 or 20 is a very useful sort of seaman.

As to the proposition about barracks. In considering that point, I want to know where the money is to come from? It is quite certain that you will not get the money now. To erect suitable barracks at Portsmouth and Plymouth would not cost less than 200,000*l.* or 300,000*l.*, and they could not be erected under two or three years. The remedy I suggest for the moment is this: I would utilise our gunnery ships more than we do. When the gunnery ships were established we had not a standing Navy, and the idea was that they should instruct a certain number of men to be captains of guns. We now have a standing Navy, and the "Excellent" still exists in the same form. Now my idea is this: Instead of a large frigate having sixty seamen gunners and instructors, I would at once reduce them 30 per cent., and every man in the Navy should pass through a short course of instruction in the "Excellent." When he comes home from sea, let him be sent to the "Excellent" for three months, and then after that rubbing up, let him go to the depôt ship. We should then find that a very small number of seamen gunners would be quite sufficient. The Officers of the "Excellent" and the "Cambridge" must remember that these ships have been made for the Navy. It may perhaps rather upset their present system, but it is for the good of the Service. It was arranged that boys, after passing through the training ships, should go to the gunnery ships, and there pass through a course of training when quite young. I am almost ashamed to say I have been told that they were not looked after, and the system was given up. Captain Wilson actually suggests that the marines shall not be marines. For if a marine does not go to sea, he is not a marine. The marine is a soldier, who passes half his service afloat and half on shore, and by that means, when war breaks out, we get men who are efficient at sea, and in ships like the "Devastation;" we only require in addition a few seamen to steer the ship, heave the lead, &c. I heard a Colonel of the Guards say in this very theatre a few months ago, that he could not get recruits for the Guards, because they would enter the Marines; and he said, "Why do they go into the Marines;" Because, in the Marines, they go to sea for three years, and return home with a pocketful of money, and they go down into their country village and swagger away.

[1] Well-behaved men can purchase their discharges.

So if you do not send the Marines to sea, you would not get that class of men. On *other grounds* I regret my friend holds that opinion; but I am very glad he does not belong to that very dangerous class of Officers who are actually proposing to abolish the Marines altogether. I say, give up nothing. If you give up the Marines, you could not increase your seamen by an equal number; for I have proved that you cannot even train your 18,000 seamen. I do think the time has come when we should no longer have marines and marine artillery. I do not see that you want the two corps. Then as to Captain Wilson's remarks about the young Officers. There is nothing so important as that. The day has gone by when our Officers can address the men in violent and abusive terms. You must command the men by example; and I think in addition to teaching this to our young Officers, it would be well if we all exercised the duty of forbearance. We must all show an example to the men. We must remember that the men on the lower deck can now read the instructions just as well as the Officers, and they are all well aware when Officers transgress them. I think these points should be attended to: and if the First Lord of the Admiralty were here, I should say you cannot be too careful in selecting Officers for command; and when there is a doubt as to an Officer's character, give the Service the benefit.

Sir Frederick Nicolson: I should like to ask Admiral Willes, if I understood him rightly, when he said that, in the olden days, say 1810 or 1812, we required 145,000 men?

Admiral Willes: Seamen and marines.

Sir Frederick Nicolson: I suppose you hardly mean that we have now such a number of ships ready to be commissioned, that we should want anything like that number of seamen. If you take the seamen actually afloat, if you take the petty officers and pensioners annually in reserve, and your Coast Guard, the total number of men would be about 75,000. Though perhaps we might have ships, and have to employ a large number over that 75,000, still I believe we should want nothing like 145,000. Admiral Willes seemed to hint at getting men from the mercantile marine; but you will hardly want the large number that were required in old days, when we had something like 100 sail of line-of-battle ships. I am afraid Naval Officers are not quite unanimous on all points. There is one point alluded to by Admiral Willes with which I entirely disagree, and that is with regard to the discharge of objectionable characters. I believe nothing has so good an effect as that, when a man has once passed through the delicate ordeal which has now ceased to be, but which has been very delicately alluded to, he should, very soon after that, if he commits himself again, be discharged. I know nothing that has a worse effect upon any ship's company than to find that there are three or four incorrigible blackguards in the ship whom the Captain cannot get rid of. I have had a great many instances myself of that, and have seen how difficult it is to get rid of these men. Once I was innocent enough to take up a deserter, who had left me six months before at Hong Kong, feeling confident enough that the Admiral would afterwards discharge him, but I was saddled with him for the rest of the ship's commission. I think greater power should be given to Captains, and certainly to Commanders-in-Chief, to get rid of bad characters, for, in that case, the higher will be the character of men in the Service, and the more the men will come to you.

Admiral Willes: Sir Frederick Nicolson is quite right. We have actually more men than we could find ships for on the first burst of war; but I have pointed out the probability of maritime war with two nations, and I am quite certain that if such a war lasted for a considerable time, we should require as many men as we did in the last great war.

Mr. Stirling Lacon: Admiral Willes has stated that this is a serious subject, and I believe it to be so; so serious, that when this paper of Captain Wilson's was put into my hands, I made out a few notes, which I will read, in order that I may occupy the time of the meeting as short a time as possible, and also that you may believe that what I put before you is properly considered. The paper is too short, but it perhaps has its advantages; it gives time for discussion, and enables us to go beyond its actual scope: and the great merit of this Institution is, that all subjects are permitted to be freely ventilated in this theatre. It has been stated by a dis-

tinguished Officer in this theatre during this session, that the strength of the Navy was 60,000, and now we find that an equally distinguished Officer, evidently one who knows, states (and I quote his words) "that it will be seen from figures that "I have already given, that we have but 12,000 able-bodied men, which is surely "as low a number as the most rigid economist would dare to advocate for the first "Naval Power in Europe." And again he says, "In sea-going vessels we have only "10,500 blue jackets of man's rate, the remaining 8,000 are in the harbour ships." When the navigation laws were repealed, and the apprenticeship system abolished, it was foreseen by the Navy what must sooner or later come to pass, namely, the gradual extinction of our sailors, and they set to work to bring up their own boys, for the boy is father to the man. I do not wish to enter into or to criticise this branch of the question; for magnificent as I believe to be the present *personnel* of the Navy, I would simply ask, does the country get the utmost that can be given for the money it spends? Boys for the Navy are brought up at a cost of 60*l.* per boy per annum, whereas boys are brought up and fitted for the sea service in the training ships at a cost of 19*l.* per boy; and I have the authority of Sir Rodney Mundy for saying, that the boys brought up for the Navy are too good, and that he would rather have a practical seaman before the mast than one that can work a double altitude. But my object in rising is to direct attention to the Reserve, of which no mention has been made in this paper, and what we have to fall back upon in the event of war. The extract given from the United States' Naval Institute Journal is sufficiently startling, and it is a justification for my entering into this branch of the subject. In former days the Merchant Service was looked upon as the nursery for our seamen, and in the great Continental war, Nelson asked for 120,000 men. Parliament, a few years ago, voted 30,000 men as the reserve of the Navy. Notwithstanding 6*l.* a-year retaining money, and 4*l.* a-year training money, and a prospective pension, it has been stated by Sir Walter Tarleton, within the last four years, in this Institution, that the numbers have annually been dwindling, and he did not think, in the event of war, 6,000 would be forthcoming. It is a most serious thing for the country, the present demoralisation and the apparent gradual annihilation of our merchant sailors, seeing, as Captain Luce says—and I now quote from Captain Wilson's paper—"Money can always be raised by the "State, and money will produce any number of craft, but money will not make "sailors: gold will not make a disciplined crew nor an experienced staff of Officers; "and of what use are ships without the living soul to command and the ready "hand to obey." Our peace Navy should be the nucleus which, in time of war, might be supplied with strength from the Merchant Service, for whose benefit—that is, the protection of our commerce—the Navy, in a great measure, exists. What could the Peninsular and Oriental Steam Navigation Company, in the event of war, contribute by way of *personnel* to the defence of the country? I have it on the authority of the Marine Secretary to the Board of Trade, who has just returned from Egypt and the Suez Canal, that these ships are exclusively manned by Lascars and Chinamen, not one Englishman on board except the Officers.

> "England, mistress of the sea,
> "With ironclads manned by a heathen Chinee!"

And what support are you, the Navy, likely to derive from your old nursery of seamen? On board ship you have a string of feathers as a vane to show which way the wind blows, and you may take these facts with the same object. During the present session a return has been laid before Parliament (Sir Selwyn-Ibbetson) of 2,600 sailors who have been sent to prison for periods varying from three to six months, with hard labour, for refusing to go to sea at the risk of their lives. Now what becomes of these men, and others, who do not wait for such tender treatment? I have authority for saying, that they are to be found in the coal mines and workshops of England; to such uses has England put her natural defenders. "But," you will say, "you must overstate, you must exaggerate; for although there is an outcry against the scarcity of men, ships must, and do, go to sea as before." They do, minus the 480 unseaworthy ships which have been stopped and condemned under the Act of 1873. Then how are ships manned? I will tell you, and I shall speak from authority. In one of the north-eastern ports the crimps have a law

shed for the manufacture of sailors. They get dock labourers—any refuse of the population—who, a few years ago, would not have been admitted on board any ship. These they equip in a sailor's jacket, and taken into the shed where there is a cart-wheel, by means of which they are taught to steer; and in the centre of the shed there is a cow's horn on a pedestal, round which they march, in order that if any questions are asked, they may say they have been round "The Horn." "But," I asked, "how are they taught to heave the lead?" That, my informant answered me, was too antiquated a thing altogether. I told all this to Mr. Plimsoll. "Well," he said, "I know how the crimps manufacture firemen at Liverpool. "They also have a shed, and they put two casks together end to end, with the bottom "and head of each knocked out, and when the recruit can shoot a full shovelful of "coal or rubbish through both, he is qualified for a fireman, but they do not "guarantee them against sea-sickness." The story of the "Cospatrick" will not be forgotten; and we have evidence since then of two ships where the crew had burrowed down through the coals below the forecastle, had broken through the bulkhead, and with naked lights had plundered the cargo. When remonstrated with by the captain, they refused to give up their plunder, and broke out into a state of mutiny, so that he was obliged to put firearms into the hands of the passengers; and, in another case, the captain, shortly after leaving the land, in a gale of wind, discovered that he had a crew, not one of whom was a sailor, and he went below and took a dose of laudanum. Such is the staff upon which England may have to lean in the event of war. You may bless your men-of-war, and your gunpowder, and your shot and shell, and your dynamite, and you may write over old England's front door "*Cave canem;*" but ships and guns won't fight without gallant English hearts to man them.

Mr. SHAW LEFEVRE, M.P.: As Admiral Willes has frequently referred to me in the course of his remarks, and appeared to regard me as that rigid economist, so much deprecated in these quarters, I will ask permission to say a few words, and first to join in giving my thanks to Captain Wilson for the very interesting lecture he has given us. No man in the Service is better qualified for the task. I came here fully expecting to hear something that was very interesting, and I have not been disappointed. I think Admiral Willes, and, to some extent, Captain Wilson also, have overrated the difficulties of the Navy in the event of war. I think neither of them have quite appreciated the very great change that has taken place of late years in the complements of our ships and the proportion of blue jackets required to other men. I recollect some time ago making a comparison of the number of blue jackets in proportion to other men in ships of war of present day and past times. In the old three-decker, such as the "Victoria," 600 blue jackets were required out of a crew of 1,100; while in the "Sultan" only 230 blue jackets are required; and in the "Devastation," less than 100. We have 18,000 blue jackets, of whom 12,000 are on sea-going vessels, leaving 6,000 disposable in our ports; and we have, in addition, 4,200 Coast Guard men, all in the prime of life, the best men we could have found anywhere. Besides that, we have 6,500 pensioners, of whom about 4,000 would be quite suitable to be put on board ship in the event of war, and in addition to these we have the Naval Reserve men. I have also made this calculation: What number of blue jackets would be required to man all the ironclads that we have in reserve, or in the Coast Guard Reserve, and all the coast defence vessels, in fact, every vessel we could possibly send to sea within a reasonable time from the outbreak of war? I believe I shall not be wrong if I put the number at less than 6,000 men; 6,000 pure seamen would be all that would be required to send to sea every vessel that could by possibility be utilized at the outset of war. I say we have a greater number than that at the present moment disposable in our ports. I do not see, therefore, that we are in any danger of falling short in the number of blue jackets at the outbreak of war. Captain Wilson has referred to the number of seamen in the French Navy; he stated that they have 22,000 seamen; but he must recollect that they have no marines in the French Service. The marine corps to which he referred is a corps specially trained for colonial service, and is not intended to be sent on board ship.

Admiral WILLES: Always in flag ships.

Mr. SHAW LEFEVRE: They are not intended for sea service; and those who have

seen a French regiment on a transport, I venture to say, will come to the opinion that, without special training on board ship, these men would be fitted for very little work at all. They are not marines in our sense of the term. Therefore, when you compare the 22,000 with our 18,000, you must take into consideration the 13,000 or 14,000 marines that we have.

Captain Wilson also referred to the number of men France has in reserve, and stated it at 80,000; but that includes every fisherman, every seaman, and every man in the remotest way connected with the sea, including ferrymen and bathing-machine men. The *ascription maritime* is so rigid that every man whose connection with the sea may be called a sea service is brought into it, and I confess my strong impression is, that on the outbreak of war, the French could count upon a very small number of these men. Captain Wilson has referred to some remarks made by Captain Luce, of the American Navy, with regard to the Crimean War, and he says they are fraught with warning to us. I confess, my recollection does not show that we have to learn any very great lessons from the French. Though they were able to man their fleet on the first outbreak of the war, that fleet was mainly engaged in transport service. They did not even send a fleet to the Baltic, and their fleet in the Black Sea, instead of being as ours, always ready for action, was performing the duties of transport. You must look to the thing as a whole, and though the French service may be well organized, and they may be able to send a great number of men on board at the outbreak of war, they have not the available resources to fall back upon that we have. I think Captain Wilson has referred to the fact, that during the American War, the American Navy was increased from a few thousand men to 60,000 men in a few months. I ask whether that would not be the case here? What reason is there for supposing the American Navy could be increased in that way and ours could not? I believe our resources, as compared with America, are enormously greater, and that though something may be said about the deterioration of the mercantile marine of late years, due to the substitution of steam for sailing vessels, yet, I think even that is exaggerated, and I am confident we have in our mercantile marine a very large reserve to fall back upon. Besides that, we have the enormous fishing population of this country, who, in the event of war, and when time is given, could be trained and made very well fitted for service. To revert to the special questions brought before, I think we must start with the fact, that 18,000 blue jackets is the force which the country considers requisite and necessary for the naval service. That number has been agreed to by successive Governments, and I think on the whole, Parliament and the country is of opinion that that number is sufficient. It will not sanction an increase. All that we can hope for, is that that number shall consist of as good men as possible, and I am quite certain the most rigid economist will hold that view equally with the best naval man, he would wish that what men we have should be of the very best quality possible, and for my part, I would spare no money for that object.

Captain Wilson has pointed out, that to fill up these 18,000 men, no less than 3,000 boys are requisite. In other words, the waste of the Navy in the 18,000 men is such, that for every six men you want one boy brought into the Service every year. That to me is a very startling fact, one which I have often had to consider, and on which I have often spoken to naval officers with great concern. Why is it there is such waste in the Navy? Captain Wilson has pointed out that in part it is due to desertion. He has stated that the average number of deserters for some years past has been 700, that the year before last it was 800, and last year it was 1,000. That seems to me to be a very large number, and I think it is worthy the consideration of naval officers and of all interested in the Navy, whether something could not be done to put a stop to that enormous number of deserters. I confess, for my own part, I think it is in great measure due to the pay. I do not agree with Captain Wilson that it is due to the other causes to which he refers; I believe it is mainly due to the question of pay, and it is a very serious question when you come to look at it, that the pay of our seaman in the Navy is very considerably below that of the pay of the merchant service. We take our boys and train them to a point, when, in every respect, they are confessedly better than the men in the merchant service, and we expect them to remain in the Service at a less

rate of pay than they can get in the merchant service. It is true that the pension is very good, and if you add the present value of their pension to the pay, it may be that their pay is about equal to that of the merchant service, yet seamen are not in the habit of looking so much to their future pension, at all events, during the first ten years of their service. It may be afterwards, during the next ten years, when the pension comes somewhat closer, it then enters closer into their calculation, but I very much doubt whether, during the first ten years, the pension operates so much as some people think. Present pay is that which operates on the seaman's mind. Therefore, for my part, I have always been ready to face the question of the pay of the seamen of the fleet. Of course it is a very delicate question to talk about. I should be sorry to proclaim it on the house-top, lest it should give rise to agitation in some quarters, which would not be pleasant, still, I think it is a serious question whether we should not force the question of an increase of pay for the seamen. If you could prevent the desertion, it would not be necessary to train so many boys, and the expense of training boys is a very serious one. That brings me to another point, whether it is desirable the whole of our seamen should be entered as boys in training ships. I confess, for my part, though thinking we ought to rely mainly for our seamen upon those boys, yet it would be desirable to enter a certain number of men direct from the merchant service every year. And here there is another point which interferes very greatly with this, and that is the difference of pay to the continuous service men and the non-continuous service men. The non-continuous service pay is very much less than the continuous service, and those men are not entitled to a pension unless they serve 21 years. I cannot understand how it can be expected that men should come from the merchant service into the Navy at a lower rate of pay than they are getting in the former; therefore I think that is a question which is deserving of the most serious consideration, whether we should not equalize the pay of continuous and non-continuous service men.

Captain Wilson also adverted, in a very able manner, to the question of the training of the men in our home ports, and I confess that is a point to which very serious consideration ought to be given. It has always seemed to me we have had too many disposable men in our home ports, who are practically doing nothing. Captain Wilson has suggested that these should be sent on board ship in lieu of marines, but that has been pointed out by Admiral Willes as wishing the abolition of the marines as a sea force. I do not agree that that is a practicable solution, but I do think it is feasible that the seamen in our ports should receive a better training. Why should not all the men who are now doing nothing in the receiving ships, go through a course very much like that given in the "Excellent?" and for my part, I think it would be wise to have naval barracks. You must house men somewhere. My experience is, looking from the point of view of an economist, that nothing is more expensive than a floating house. I believe it would be a wise thing to do away with many of these old floating houses in our home ports, and house the men in permanent barracks on shore; and at the same time, if better training could be given to the men during that interval, it would be an extremely wise course to take. A good deal of desertion is due to the men having nothing to do, and at all events, looking at the very great expense which we go to in training, educating, and bringing up these boys, I do not see why we should not make every one of them equal to the average men that we turn out from the "Excellent" and "Cambridge."

In conclusion, I must again thank Captain Wilson for his interesting and suggestive paper.

Captain FitzRoy, R.N.: So many allusions that have been made by the gallant Admiral who first spoke with reference to young Captains, that I think I am quite justified in making a few remarks. I will endeavour as much as possible to confine myself to the point of the lecture which I consider a very important one, and one deserving the gravest consideration by the authorities, that at the present moment there are in the home force a number of ordinary seamen that there is no sufficient accommodation for to enable them to keep up their drills properly that they have learned in the training ships when boys, and that there are not sufficient ships to take them to sea, and to enable them to learn their duty as seamen. And the first

remark I would make is with reference to the free kit and allotting. Now that the Admiralty have given a £5 free kit to each boy who enters the Service, and have also permitted them to allot, I have no doubt the Midland Counties and Wales will send numbers of boys to the training ships. We must remember, in dealing with the blue-jackets, we are dealing with the sea-faring section of the labouring class; and that parents in sending a boy to sea lose one of the bread winners. Formerly they did not realise the fact that they would get any money by sending a boy to sea till they got their allotments as ordinary seamen; but now, having their allotment at once, they will very soon begin to see that a boy at sea can assist in the general support of the family.

The most important point is the waste in the Service from discharges and desertion. Something has been said about ten years' men not re-entering. I think many ten years' men would re-enter if they were allowed to have a certain time on leave on full pay, and then returned to a ship in a home port. Desertion is due to several causes; and when we consider what the lecturer has stated that the enormous sum of between £200,000 and £300,000 is lost to the country in a year by desertion, it behoves everyone to think very seriously how it can be met. This £200,000 or £300,000 represents three small corvettes, two large ones or one second class iron-clad, which represents three, two or one Captain on full pay instead of half; or, to bring it more home to the British taxpayer, it represents two or three times as much as the wages of the Coast Guard Service voted this year, which was £93,000. That is very serious. Amongst other causes there is of course the old one of dislike. There is a new one which is, and the higher you educate the boys the more it will come forward, and that is they find they have not sufficient scope for their abilities. Another one is debt; another one is domestic causes. What I want to speak about particularly is the cause of debt. A boy after he leaves the training ship is rated as an ordinary seamen. If he is a good boy he is put at once into the first class, and put upon special leave. He becomes a "pure blue-jacket;" and being on special leave can go on shore three or four times a-week. If they are away from their own home, how do they find means for all this? Why, the answer is, they must run into debt. The first thing they do is to borrow money on shore; then they go to the lower-deck bankers. In all ships there are a certain set of men —for leave has become so generally established and so well understood—who hardly ever put their feet out of the ship except when close to their own homes. They go to the pay-table regularly every month and take their wages; and those wages are lent out at interest and usury to these young seamen who want to go on shore.

There is another set of men who allot and remit their money to people in the home ports, who lend it in the same way at great usury to any ordinary seamen. This goes on for a long time; and, if a lad is not very steady, he runs probably greatly into debt. He finds he has no hope of ever paying, and makes a clean bolt. I am sure that is a very prevalent source of desertion in the Service now. To meet that, there is nothing like increase of pay. I do not think our seamen are half well enough paid, considering that they hold their lives in their hands perpetually. I also agree with what Captain Wilson says about permitting young ordinary seamen to buy their discharge. A discontented man on the lower deck is no use. He may just as well go in peace time. I very often had lads come before me begging and praying for their discharge, saying they quite misunderstood the Service; and when it has been refused they have remained in the ship sulky, and doing harm on the lower deck.

We should also hold out more inducement to petty officers. At present I do not think half enough inducement is held out to induce petty officers to qualify and bring themselves forward for warrants. It is a difficult matter to deal with, because there are so many claimants. I would, therefore, suggest the establishment of a fourth class of warrants—men who would clearly be at the top of the list of first class gunners, boatswains, and carpenters[1], men whom really we should be very much better without in seagoing ships. I have great respect for them, but, at the same time, I would sooner have a third class boatswain than a first class. At present it

[1] This fourth class should be all the senior men for duty in ships in home ports and in second reserve.

is a most difficult thing to get a petty officer, however deserving, a warrant until his turn comes. I know in the first ship in which I went to sea the Captain of the foretop was only 19 years old, and the Captain of the maintop 21. They were both first class petty officers, and the Captain of the foretop at 21 was a boatswain, and one of the smartest I have ever been shipmate with. The lecturer has remarked on the increase of non-combatants. That is due chiefly to the enormous number of stokers that our ships are obliged to have. As you increase the horse-power, so you must increase the number of stokers; but I think it is quite a mistake to say that they are non-combatant. They play a most important part; and, at present, we have not a sufficient number of them, for after steaming two or three hours at full speed, we are obliged to send down deck hands to help. Our magazines also require many more men to work now than in former days. The powder has to go greater distances, except in a few ships, and all these not-combatants are employed as magazine men or shell-room men all over the ship.

As to naval barracks, I think it is only a question of time. As the rotten old hulks in our harbours where seamen are accommodated are worn out, it will become a question what is to take their place. There is not an ironclad in the Service that has accommodation for over 600 working blue-jackets; therefore the question will be, what is to take their place. The "pure blue-jacket" will either be houseless, or they must build barracks on shore; and I think it would be a wise and far-seeing policy on the part of the House of Commons, if they were to vote certain funds every year towards the erection of those barracks, instead of waiting until the time comes, when they must absolutely be built, and they have to provide a lump sum all at once. I do not agree with removing the marines. If it is necessary to have marines at all they ought to have sea-legs, and to get accustomed to the lower deck. If they are to be done away with, it will be when our barracks have been established for two or three years, and then I think they will die out of their own accord, as no longer required for the purposes they were originally raised for.

With regard to the strength of foreign navies, if we substituted the term sailor for seamen, it would meet the case better. There are a great many sailors in all foreign navies, but not very many seamen. It does not do to depreciate one's probable opponent, but that is the fact as far as I have seen.

One remark has been made with reference to the discipline of seamen and marines with which I am sorry I cannot agree. In many ships you may have the bad luck to fit out with a bad lot of marines and a good lot of seamen, and *vice versâ*. But taking the average of the last ten years since the continuous service has been in working order, I must think the seamen are, if anything, certainly superior at sea in discipline to the marines. For six weeks in the spring of last year I was at Plymouth, and during the whole of that time I only saw one blue-jacket badly dressed or drunk in the streets, and that man belonged to my own ship; but I saw several men with red coats on, drunk and disorderly. That is, of course, a question on shore, but I mention it to show how much better their conduct on shore is now to what it used to be some years ago. I attribute that mainly to the admirable system of training, and the very good results of the training establishment over which my gallant friend so ably and zealously presided for three years.

Lieutenant Graham Bower, R.N.: Captain Wilson has so well put the case that I have very few remarks to offer. There is one subject on which I wish to speak. It seems to be assumed that our ironclads cannot carry more men than they have on board at present, and that we are unable to train the men we actually have at sea. In the last ship to which I belonged (the "Pallas") we had not sufficient men on board to man the guns. Their place was taken when we left England by a hundred supernumerary boys. On arriving in the Mediterranean, this 100 was reduced to 50. But the mischief of the thing did not end here; the boys were very young and were not able to do mens' work at the guns. But besides this, we had not sufficient rifles or arms on board to arm the men, that is to say, our arms were supplied for our complement and not for the supernumeraries. The result was, when the boys fell in they were unarmed except with boarding pikes and such weapons as would be almost contemptible.

Another point is the abolition of the marines. I believe many of the younger

Officers in the Service would wish to see the marines done away with, but we should be anxious to know what is coming to take their place: It must be a great waste to employ a seaman whose service of training has been a very expensive one in the ordinary deck-duty which could be equally well performed by an able-bodied landsman with a very slight sea training: If we establish naval barracks and enlist landsmen with the seaman's dress, and under the authority of the Captain and naval Officers, then perhaps many of us would wish to see the marines done away with. Landsmen enlisted under the authority of the Captain would, no doubt, perform the duties of the marine as well as at present, and it would do away with the anomalous system of having two Captains in the same ship. The marine's dress is a burden to himself. His shako is an anomaly, and if we had marines enlisted in seaman's clothes under our own Officers, I have no doubt that many of us would be glad to see the old marine done away with, but we certainly should look at any change of that sort with anxiety unless we knew what was going to replace them.

Commander W. Dawson, R.N.: I cannot resist from offering my congratulations to the Institution in having such a very able and instructive paper read. I agree thoroughly with the great mass of what has been said. The only point on which I am at all inclined to take exception, is, as to the Royal Marine Corps. It will be in the memory of many Officers present, that about a year ago a paper was read on the question of marines *versus* blue-jackets by Major-General Schomberg; and I am sorry that he is not present to-day. I think it is an open question whether marines should be a part of a ship's company or not, but if marines are to be part of the ship's company in war, they must be trained as marines and not be mere soldiers. What is it that constitutes a marine? What converts a soldier into a marine? It is not only going on board ship and getting sea-legs. The sea soldier has a very difficult position to fill—that of learning to obey promptly the orders of Officers who belong not only to another corps, but to another profession—Officers whose ideas, manners, ways, and language, are utterly contrary and opposed to those of the Officers of his own Service. This subordination, to two widely differing sets of masters, is one of the most important distinctions in the training of a marine on ship board; and if the marines are not to be so trained, by all means let us do away with them, but do not let us have a corps called marines who have had no practice at sea, and have not acquired the specialities of sea soldiers. If we must have land soldiers, let us have them under their proper name. But what is it that distinguishes the two portions of the Queen's sea-service, and makes Naval Officers so long for the presence of the marine? It is that the marine has acquired some quality in the course of training which the blue-jacket does not possess. That invaluable quality which we all desiderate, he gets in the intervals of service afloat. In the interval of service afloat, whilst he is in reserve, the marine receives a course of disciplinary training which revives what he has unlearnt at sea. Why on earth, as Captain Wilson has so well put it, should not a blue-jacket in the same interval be receiving the same invaluable disciplinary training, instead of deteriorating in subordination and general discipline in the very same period of reserve?

If these intervals of harbour service were utilized for seamen as for marines, instead of being utterly wasted, and worse than wasted, the seaman might receive a disciplinary training, making them the equal of the marine in that invaluable quality of subordination. We get the seaman originally from a better class than the marine recruit, and he is carefully trained from youth and moulded into whatever form the Navy chooses. A marine starts, say, about the age of 20, so that from that age we find the two classes starting from very different foundations; yet, such is the superior disciplinary training given by marine Officers, that we think the Navy could not exist without their aid.

There was another point I was very glad to see brought out, namely, the very wide distinction that there is between conduct and discipline, and I should like to see the same distinction enforced between drill and discipline. Drill may be employed very largely to promote subordination, prompt obedience, and discipline, but it is not in itself discipline, and it may be conducted as not to conduce to self-surrender and discipline at all. There is no reason why a most invaluable course of

disciplinary training should not be gone through, in the intervals of sea service, by seamen as by marines, instead of that idle time now spent in port, to the deterioration of good order and discipline, by which our seamen lose a golden opportunity which is now utterly thrown away. As far as organization, subordination, and discipline are concerned, seamen are really in a worse disciplinary condition when they return to sea than when they leave the sea-going ship. There can be no question but that when the men are disembarked from the sea-going ship at the end of a commission, they are in a far higher disciplinary state than when they are drafted to a new ship. Thus public money and public service is extravagantly wasted during considerable intervals of sea service in the case of seamen; whilst the very reverse is the case during the same periods with the Royal Marines; and I do not think it is possible to subject seamen to the same excellent disciplinary training which the marines gain on shore, until we have put the seamen also on shore in barracks. I believe thoroughly what fell from Mr. Shaw Lefevre, namely, that barracks would, in the long run, be far more economical than harbour ships. No habitation is more expensive than keeping a ship and her appurtenances afloat. Besides that, you must look to the waste of money on the men idling, and worse than idling, in hulks in our harbours. This costly time could then be usefully employed, and there could then be a continuous system of training—training at sea in seamanlike exercises and gunnery, in training in harbour in disciplinary exercises. I use the word "disciplinary," in an advised sense in contradistinction from drill, drill being merely the engine by which discipline is imparted. I was very much pleased with what was so ably stated by Captain Wilson, on this most important question. Very few naval Officers have the slightest notion of the chain of graduated authority which obtains between different ranks in the Army, and which ought to obtain between different ranks in our own profession. There is in the Queen's regulations, a certain page with a certain list of the gradations of rank of the different petty Officers. I am quite sure not a single petty Officer in the whole Navy could repeat the gradations of that chain. We repose as little confidence, respect, and authority in the chief petty Officers as in the ordinary seamen, and it is extremely difficult to discern any difference in their treatment. Let us compare the trust and authority reposed in the chief petty Officer of the Navy, with that of the Colour-Sergeant and the Sergeant-Major of the Royal Marines. Every naval Officer must be conscious of the wide difference in the position and treatment of these two. Compare again the trust, respect, and authority conferred upon the petty Officer of the Navy with that of the Sergeant of Marines, and the difference in the treatment of the two is obvious to all Officers. The treatment accorded to them by their Officers, makes a great difference in the authority and the position that they hold with reference to the men under them. You will thus understand what I mean by that chain of graduated authority which disciplines the marines and the Army, and which gives them that great advantage with reference to discipline, which makes us desire their presence as the backbone of organization and order in the Royal Navy. Whether we have the marine or not, is simply a question of subordination, order, and discipline. If we could, under any system of training, in the intervals of service at sea, bring men-of-wars-men up to the same efficient disciplinary standard as the marines, then when they are in harbour they would be doing good to themselves, to the Service, and to the country, whilst being brought up to the state of obedience and order that characterise the marine forces. Were that done, I do not think there would be so much objection on the part of naval Officers to do away with the corps which is so deservedly the pride of the Navy; but so long as that royal corps remains, it should be a corps of real sea soldiers. Let them then go afloat; let them have their regular turn at sea.

The other question, as to the difficulty of training the boys who are now being brought up in harbour, I think might easily be got over by substituting a few frigates for some of the ironclads at present in commission. This would secure to them opportunities of learning more seamanship; but I am not prepared to sacrifice the efficiency of one corps in order to promote the efficiency of another.

One observation fell from Mr. Stirling Lacon which might be liable to lead to error. He spoke of the Naval Reserve having fallen in numbers. Most of us who have attended to these matters know that the Naval Reserve has recently gone up

very largely in numbers—17,000 at the present moment. Of course it is still very far below in numbers what most naval Officers would desire it to be; and as I am at present connected with the mercantile marine, I may be pardoned in saying that merchant seamen have been rather hardly treated to-day. There are, there is no question, a great number of blackguards, who are not seamen at all, in the mercantile marine, and a great many good-for-nothing long-shore fellows; but there are, on the other hand, a great many excellent well-conducted men and very excellent seamen to be found in the mercantile marine; and if these men have not joined the Reserve in the numbers we expected, depend upon it there is some good cause for it, which will probably be found in the regulations under which that force is constituted. I hope Mr. Shaw Lefevre's notion to bring men who have passed their prime in the mercantile service into the Navy, will not be carried out, for most naval men must know that it is extremely unpleasant to good merchant sailors to find themselves in a position of inferiority as learners of a new business on board a ship of war at an advanced age, and all the past experience of the Navy tells us that their entry is not for the advantage of the Queen's Service. If we could persuade men-of-wars-men to go into the mercantile marine, that would be another thing, but I do not see my way to persuading men-of-wars-men, after they have enjoyed the luxury of a ship of war, to submit to the hard life of the mercantile marine, in the miserable way that service is too generally conducted at present.

The CHAIRMAN: General Schomberg is unfortunately unable to be present to-day, but he has forwarded some written observations on the subject, which the Secretary will read.

Remarks by General SCHOMBERG: I restrict my remarks to that portion of Captain Wilson's lecture which treats of the Royal Marines as the first reserve of the Navy, and his proposals to render the marines a sufficient reserve, as they are now an efficient and ready one.

Five years ago I raised the question in this lecture room, "Are the Royal Marines "a necessary auxiliary and reserve to the Navy?" The discussion that followed certainly supported my views, that marines are necessary to the Navy. I remind my present hearers that I left undefined how far the marines should be auxiliary or reserve; and that I especially remarked that I bowed to any necessary measure for the training of the Navy proper.

But, although on that occasion the votes of the Naval Officers present were much in favour of retaining the marines, I do not think the solution of the question has advanced one stage since my lecture in 1870.

It does not become me to discuss events that have occurred connected with this subject; but, in my opinion, we are still "halting between two opinions," to the detriment of the Navy and its limb, the Royal Marines; the lopping off of that limb, I still believe, would maim and cripple the body, the Navy.

The distribution of the Royal Marines which Captain Wilson proposes is almost exactly my own ideal for very many years; but I have always felt that such a proposal must come from a Naval, and not from a Marine Officer. I hail with hope the publication of these views by an Officer so distinguished as the lecturer, than whom no one can know more intimately the state of the Navy, and how the system of training the Navy works.

I do not undervalue in the least degree the Royal Naval Reserve, but, however valuable that force may be in the course of a long naval war, it can never be the first reserve of the Navy. The first reserve must be ready as your revolver for instant service; it should embark by telegraph; and at present I see no reserve of the Navy which can answer these conditions except the marines.

I doubt whether many individuals in England realise the stress a great naval war would throw on the Navy.

It is true that machinery enables one thoroughly trained man to do the work done by many in by-gone wars; but, on the other hand, we must consider seriously how much more we have to defend than we had in those times. First, the arsenals and hives of industry on our own coast, an empire in the east, a dominion in the west, a continent in the south, an island and a port in every sea, and a merchant navy carrying to and fro unheard-of riches.

The first reserve, in order to enable England to defend this, must be numerous as well as efficient; 10,000 to 15,000 men, ready to embark by telegraph, would not be an excessive number.

Captain Wilson's suggestion to garrison two of the home seaports entirely, and several foreign ports partially, with marines, would meet this completely.

I also am of opinion that there would be no difficulty in keeping up the training of marines in these garrisons, starting from our present marine system, which has been the gradual growth of many years, and enables us to take a man from the plough-tail, and, with two years' training, to send him on board ship, fit to compete with a gunner of the "Excellent;" no mean feat of instruction and training.

I believe that with this system, now so well matured, and with judicious measures to ensure a short sea training for these marine garrisons to accustom them to work hand-in-hand with the Navy, there would be no danger of the marines becoming a purely military force. There is no occasion to enter into details of these matters at present.

There would be no necessity for changing the organization of the Marine Service, or increasing the proportion of Officers to men; the force would still remain the most economical force under the Crown, and its distribution, as proposed, would remove its crying evils, viz., the non-employment of its senior Officers, and the idleness enforced on its Officers when embarked.

Captain R. A. E. Scott, R.N.: I wish to add that my own experience coincides with the views Captain Wilson has so ably expressed. As regards other speakers' opinions I do not think that the plan of bringing seamen from the Merchant Service into our Navy would be of much value. Rather than this, we want more boys, and these more highly trained than boys are at present. We now work all our heavy guns by machinery, and it is an increase of machinery that we must have recourse to in time of war to supplement a small amount of labour. Now the time when people can best master the working by machinery, and when they feel most interest about it, is when they are young. Instead, however, of being trained to use machinery, boys are merely drilled with handspikes and tackles; and that at a time when they should be instructed in manipulating the machinery of our newest guns or models of them. It has been said that we do not want many of such skilled gunners as those the Navy now possesses; but I think not only do we require more skill amongst our seamen-gunners generally, but that the low standard of skill is not creditable. We have only four large guns in some of our biggest ironclads; and hence the men firing them ought to be highly-educated marksmen. To encourage them to become so, their pay, and in fact the pay of all the men who are really skilled marksmen, should be very much increased. Then as to the disciplining the crews in our home ports. This might be carried out so as to be made interesting; and the drills to be mastered should be taught as if to intelligent men rather than to machines so that instead of our seamen acquiring the art of firing very much at random, or at best by the rule of thumb, they would learn the principles of, and gain such accuracy in, laying guns, that on going on board ship they would be able to hit the mark almost as certainly with big guns as the marksmen at Wimbledon do with their rifles. Accuracy of fire is everything with the present armaments, and that cannot be attained by undrilled men. Therefore it is essential to educate them up to the highest point of efficiency in aiming, and that can only be done in harbour. As regards the cost, I believe, if it were pointed out that the Navy required more money (and we have just heard the weighty opinion of Mr. Shaw Lefevre), the money would be voted at once, and even more readily; still, if it were clearly shown that we have not half enough vessels to protect our commerce, no one can doubt that if a minister came boldly down to the House, and stated that the Navy was not in a satisfactory state, being dangerously deficient in cruisers, that the money would be voted and the necessary vessels immediately equipped. Were this done we should have no more of those panics which we are now so liable to; for the addition of a dozen or more powerful cruisers would render our Navy far superior to any combination of navies that could possibly be brought against us.

Captain Wilson: I shall answer, as far as I can, the objections raised to the paper categorically. First of all, I have to meet a very dangerous critic, Admiral

Willes. He thinks it is a pity I did not enter upon the whole question of the entire force of the Navy; but I purposely confined myself to the seamen of the Fleet, because I look upon them, as I have tried to explain in my paper, as the leaven which is to leaven the mass, and that they are the men who should be brought up to the greatest state of perfection in peace time, ready to meet the exigencies of war; they must be highly drilled men, and should take the same position in the Navy in war time that the Guard occupy in the Army. They should be as highly trained, or they ought to be as highly trained, as fighting men as our Guardsmen, or our colleagues the marines. I do think the greatest admirer of our present system would dare to say our 18,000 or 19,000 seamen are to be compared in drill or discipline to the 3,600 marine artillerymen whom we have in barracks at Portsmouth. Taking them all round, as fighting men they are inferior; and, at the very best, our Admiralty do not pretend to say we have more than one-half worthy of being classed as trained men; therefore we may naturally infer that 9,000 of our 18,000 or 19,000 men are untrained men, or so very inefficiently trained that they are not worthy of the penny a-day given to those classed as such.

As to the reserves of the Navy, I am at issue with Admiral Willes. In the first place, I do not think you can find 7,000 or 8,000 naval pensioners fit to go to sea. We pension off only some 300 or 320 men per annum. Allowing the waste on that number to be the same as we find it in the Fleet (or at twelve per cent.), it will be found that we can only have some 1,500 or 1,600 men between the ages of forty and fifty. Every person knows what a sailor is when he is pensioned, and I think no one will question it when I assert that not more than one-half of these are likely to be fit to be sent to sea; therefore, instead of having 7,000 or 8,000 naval pensioners, I say we have 700 or 800 really available.

Admiral WILLES: I included the marine pensioners.

Captain WILSON: I have confined myself strictly to sailors. As to the naval reserve men, we are supposed to have 14,000 or 15,000, but I do not think you can ever calculate on being able to get more in the first three months than from 4,000 to 5,000 of these men. Out of our 3,600 Coast Guard men, we might possibly be able to get 3,000 fit to go to sea, but a great number of them have stomachs, and are not fit to go aloft; they serve on until superannuated, therefore many of them are elderly men. Our total number of sailor reserves is therefore altogether about 8,500, which is all England has to depend upon as *bonâ fide* seamen reserves, and out of these we should not have above 3,500 who are really trained and disciplined men-of-wars-men.

Admiral WILLES: The fewer the number the better for my argument.

Captain WILSON: As to where you are going to find the other seamen we hear of I cannot tell. Mr. Shaw Lefevre said, during the Russian War the French ships were employed in transport. That does not prove their men-of-wars-men were not highly trained, or that they had not the men to man their ships; their men-of-war were used for transport, because they had not a mercantile marine which could provide proper ships. My argument is, therefore, still good, the French *had* the men, but we *had not* the men. We all know how our ships were sent up the Baltic during the war; I was then mate of the lower deck in a ninety gun ship, and I remember well how, one night, 350 fellows were marched on board who had never seen a ship, excepting from London Bridge. I say, if in time of war you want to expand your crews, it is infinitely better that your additional men should be *disciplined* and not raw hands, and that these men should be the marines. There is another point to which I wish to draw attention, namely, that reducing the large ships of the Navy is necessarily detrimental to the efficiency of the Service; every time you pay off a large ship, or an economising Government for instance reduces the Channel Fleet from eight to six, or from six to four ships, or who may take a ship away from the Mediterranean, in the same ratio as you decrease your large ships do you decrease the efficiency of the Service, because those large ships make the men-of-wars-men.[1] The number of men does not alter, but the number of ships

[1] With barracks in which men could be disciplined and trained as *fighting men*, we should not have to depend so entirely on the large ships as we have to at present.

that make your *men-of-wars-men* are often increased or decreased; decrease your large ships, and your men are drawn into those which *absorb* men-of-wars-men, but do not *make* them. No ship that is not fully manned, and therefore able to carry out a systematic routine throughout, can possibly train or discipline men-of-wars-men properly.

I think, also, as Admiral Willes suggested, and it must be recognized more than it is at present, we must not complain because we have so many young hands or too many boys, or that we cannot get on in one ship, and cannot shift our topsail yards as quickly as they used formerly, because our crews are light; we must recognize the fact, that the Navy in peace time is a great school of training for war, and that every ship in the Service is a training vessel; such must be understood and clearly recognized by every Officer in the Service. I remember when I was a young commander, a First Lieutenant telling me he did not consider it his duty to train seamen; they ought, he said, to be seamen before they came into the Service. Officers do not always understand that it is their duty to teach, and therefore will not give that attention to the subject which it deserves.

Now we come to the question of discharging men. As I tried to express, I do not believe, especially on such stations as the Pacific and Australian, that any amount of punishment given to a man when he is *recovered* will ever prevent one deserting. I know, if I was a seaman, I should, under like conditions, very probably do so myself. I simply throw out the suggestion. I do not mean to say for an instant you are to publish an order that any man who wants his discharge is to get it with a stroke of the pen, but you might draw up a scheme by which a man would be able to get his discharge, say after giving three or four months' warning, after paying a certain sum, &c., &c. What is the case at present? The Admiral's ship in the Pacific has lost some 200 out of 300 of her seamen! What is the good of saying you will punish these men? Two-thirds of them, when they go, find on shore that they cannot earn their bread and butter, and if they could come back to you, they would. Let them have their discharge, let them go, and half of them will return to you, and never go again.

Then as to petty officers, I think myself we have too many of them. I would rather pay the men a higher rate throughout the Service, and reduce the number of petty officers. Captain Dawson spoke about the petty officers' position. I quite agree with him; but how can you give a petty officer his proper position when every third man of your able seaman is one? You cannot have every third man standing off. If you reduce the number of your first class and chief petty officers, and treat them as stand-off men, and the others as working petty officers, you may be able to do it. The position of petty officers has been very much improved of late years; in the "Impregnable," I was very successful in putting the petty officers in positions of command; they were the divisional officers, and I made them do everything exactly the same as a Lieutenant in a regular man-of-war, and they did it admirably well. When I took the training service I found but one set of people in authority, viz., the police. I said to them, "You men are "here to *keep the law*, not to *make it*, and you will be good enough only to carry out "orders and prevent irregularities." That plan was thoroughly successful. Our petty officers were punished only by dismissal from the ship, and I found the better I treated them the more I raised them, and the more efficient and better they were in every way. As to the marines, Admiral Willes must understand I do not wish to see the marines done away with, that would be a result which I should regret very much indeed. The marines are admirable men, and are absolutely necessary to the Navy in *time of war*. I only say this: if you cannot—and you cannot—send all your seamen to sea, then let us make our *blue jackets* sailors, and not the *marines* into sailors. You want a certain number of deck hands who need not always be sailors, let them be marines; but a deck hand in peace time is acquiring his art as a sailor; therefore keep your sailors going as deck hands in peace, but replace them by marines in war. As a *fighting man*, a young marine is quite as good as one who has been to sea all his life.

Admiral Nicolson said something about the number of men—that we would not want so many, that we had more than was necessary to man all the ships we now had. When the American war broke out, the Northerners might well have

said, "Well, we do not want more men, because we have as many as will man all "our ships!" But where were they three months after the war? They could not get seamen, though they had at that time nearly as large a mercantile marine as we had, and they had to embark 18,000 landsmen on board their ships. If they had had to face a maritime Power of the third or fourth order, they would have been smashed. They had to put men into ships of all classes and build! You have in time of war, not only to man the ships you already have, but you must buy others right and left.

Mr. Stirling Lacon made some observations to which I wish to raise objections. In the first place, he speaks of the training of our boys, and says that each boy costs 60*l.* a-year, and merchant seamen boys cost only 19*l.* I think his estimate is high. I say our boys in the Navy cost under 40*l.* As to boys trained for the Merchant Service, I can simply say they are very inferior. I am not prejudiced against private ships, but the boys are no more trained, as compared with our boys in the Navy, than a mere militiaman is to a Guardsman. They are not even physically fit for our work. The whole of the merchant training-ships put together (including the "Warspite" do not supply us in the Navy with 50 boys per annum. You hear of Lords of the Admiralty going down and making long speeches about these vessels being feeders for the Navy, and all that sort of thing, but the fact is they are nothing of the sort. The boys are so much inferior in *physique* that we actually won't take them in the Navy; and as to the training, it is anything but complete. The very best lads, and who are worked up to a comparatively high state of perfection, are the boys who come from the "Warspite," but they are never able to pass higher than into the second class in the training service; therefore I think if Government does pay 60*l.* a-year for their boys, they get a cheaper article than the merchant training-ships for their 19*l.*[1] At the same time, I agree that the country does not get the value of its money in the training of our *seamen*. I believe that if the whole fabric were swept away—if you could wipe out the whole system (?) of training for the Navy—and re-establish it on a sound footing, get say half-a-dozen intelligent men together, they would put it on such a sound footing that you would have your men thoroughly instructed as fighting men, better instructed as sailors, better disciplined, and in every respect more efficient men; and this could probably be done at considerably less cost than at present. You will probably have noticed in the accounts of the recent wrecks what a large proportion of sailors were saved. The fact is, that the qualities you get in a sailor are made by the work he has to do, in a great measure, aloft in ships. You teach him self-reliance and brace his nerves. Look at that fine fellow as he clambers down the topgallant lift on a dark, stormy night to spill and furl his sail; what enormous self-reliance that man must have! Look how he must think for himself, and rely entirely on himself! To be a good sailor, a man must have plenty of determination and presence of mind, be ready of resource, and, above everything, he must think a-head. A sailor who thinks a-stern is of but little value. Take the case of these wrecks. Your landsmen lose their heads, but your sailors keep them. It was my good fortune to live through a disaster of that sort. What was our experience? 90 per cent. of the poor fellows who were lost, were lost because they were *shoremen*, and did not keep their heads. The bulk of the seamen and old marines were saved, and there was the means of saving every person there, and many more would have been rescued had they only kept their heads. That is one reason why I so strongly deprecate this large introduction of undisciplined shore element into ships. Your sailors are taught habits of self-reliance, and marines have their strict discipline; but your undisciplined men would rush about like a flock of sheep; and, in case of disaster, or in case of a ship being struck by a torpedo or anything of that sort, your 50 or 57 per cent. of undisciplined non-combatants would severely hamper, if they did not walk away with, all the disciplined element altogether. We were speaking of highly trained men; and a good deal has been said about special guns crews

[1] The fact is that, on an average, boys in private training-ships are kept for two years, and cost about 22*l.* per annum; therefore the *training* of a boy costs about 44*l.* for the Merchant Service, against under 40*l.* for the Royal Navy.

But fighting our guns is not all the work seamen have to perform; it is only one part of their work; they have to lay torpedoes, to land and storm fortifications, and to do a thousand and one things besides; and unless the seaman is fit to do all these things, he is incomplete. Fighting a big gun is only one part of his duty. As to stokers for fighting purposes in fleets, they are well enough as they are; but where are you, if you are going to land or use your boats, with 70 or 80 stokers, who do not know the breech of a gun from the muzzle, what are you going to do?

Captain FITZROY: Take the marines.

Captain WILSON: The marines are not enough; you have 60 marines, and you want, say, 360; and besides, when you land for any war purposes, are you going to take all the fighting element out of the ship, and leave only men unable to defend themselves or ship? If that argument holds good, why should sappers and miners ever be drilled at all? but they are as good fighting men as they are workmen, so should all men be in the Navy.

Mr. Stirling Lacon spoke about the (merchant) seamen breaking into ships' holds. What are our merchant seamen recruited from but from your prison ships? Can you wonder at the result? I do not.

Mr. Shaw Lefevre made some very telling remarks. When I was Captain of the Training Service, I received every assistance from him, and what is more, whatever money we wanted was readily granted; no expense was spared in that department by the Admiralty, and I never asked for anything which was not at once allowed, therefore I will say, in favour of the Admiralty, there was no parsimony, and Mr. Shaw Lefevre's views on all these matters were most advanced and liberal. The smaller our ships' companies are, and our crews must get smaller every year, the more reason is there why they should be highly and thoroughly efficient. We have no room for half-finished crews; *every man* on board should be a thoroughly trained *fighting man*, if he is nothing else, now they are not so. I do not complain of the *number* of our men; I think the number of our standing fleet is sufficient for peace time, but I complain of the *quality;* I do not think the quality is as good as it should be. Mr. Shaw Lefevre spoke of the French Reserves. If the French Reserve comprises all their maritime population, I can only say this, that they take the best means of passing an enormous proportion of them through their Navy, and what is more, in two years they put more drill into their men, and make them more thoroughly efficient men-of-wars-men, than we do in six. They have a power to do so which we have not got. Their men are not volunteers, they are bound to be there and they can grind it into them; morning, noon, and night they are drilled. If we gave our men one-half of the drill they get, we should not keep a crew together a week. It is not our fault therefore, I am only pointing out how we stand.

Speaking of the desertions, I say there ought to be a committee appointed at the Admiralty to examine into the question of desertions. I feel confident that desertions arise, in a great measure, from the inadequacy of the pay; but there are besides two or three other causes that act as well; I think a very large percentage of the desertions come from the class of boys who are entered late. I tried the experiment of examining into the cases of all boys who deserted in the training service while I was there, and I found 70 per cent. of them were from those who entered over 16 years of age; I think you would find that 80 or 90 per cent. of deserters go from lads who enter late. Besides that, there is the insufficiency of food and also bad accommodation. How can we expect sailors to remain on such a station as the Pacific? The "Fantome" (one of a class of six or seven) went to sea in the depth of winter for that station, with no place for 25 or 30 of her crew to sleep in except under an open forecastle surrounded with W.C.! If it had come on a hard frost when she was fitting for sea in the month of February, these men would have been frozen in their hammocks; their accommodation must be improved and more considered than at present when ships are designed.

I am strongly in favour of having barracks on shore, you could then afford to enter a certain proportion of *men* (and we must ultimately take to that course), because you could therein discipline them; you can never discipline men thoroughly on board ship.

Admiral SIR F. NICOLSON: You mean you would enter them older?

Captain WILSON: Enter *sea-faring men older* and discipline them in the barracks. I think that suggestion also, of passing all the men through the gunnery ships would be a great improvement. Captain FitzRoy doubted my assertion that the discipline of the Navy was not so good as it should be, and spoke particularly about the Channel Fleet.

Captain FITZROY: I mentioned my experience at Devonport during six weeks. I did not mention the Channel Fleet.

Captain WILSON: Though, as you may say, the marines are not as well dressed as the blue jackets, I will ask you whether you ever heard such a thing occur with them as this. There was a Colonel of a regiment at Devonport who came out on his horse to go his rounds. Three men belonging to one of the ships at Devonport were standing outside, and when he came out, one of them stood before him and called to the others, "Come here Jack, come here Bill, and look at the 'bloody "'Shah!'" I would ask you all, is that discipline?

The CHAIRMAN: At this late hour, and after this lengthened discussion, I think it would be unnecessary for me to make any remarks, except just one, which is this, that I should be very sorry, sitting in this chair, not to express an opinion adversely to any idea of doing away with the marines in any way. I think, not only are they a most deserving corps in themselves, and most useful at present on board ship, but there are many other reasons which have not been counted upon, and which I do not choose to go into at present, why I think, we should most decidedly retain the marines, and retain them as part and parcel of ourselves. The more pleasant part of my duty is to ask you to return our thanks to Captain Wilson for this most interesting paper, and also to those gentlemen who have taken part in the discussion. I feel it will do a great deal of good to get all our opinions out on these subjects, for we want a great deal in the Navy, and I think this will help us towards it a good deal. There is one point we may be very glad of, and that is, that our very good friend, Captain Wilson, did not desert in Australia.

Evening Meeting.

Monday, June 28th, 1875.

Major-General J. T. BOILEAU, R.E., F.R.S., in the Chair.

NAMES of MEMBERS who joined the Institution between the 15th and 28th June, 1875.

LIFE.

Holdsworth, Walter J., Lieutenant Lanark Yeomanry Cavalry.
Thornburgh-Cropper, E. D., Lieutenant West Kent Militia.

ANNUAL.

Sands, W. H., Captain, 6th West York Militia.
Hall, Samuel W., Lieut.-Col., Assistant Controller.
Birkbeck, Robert S., Captain, 6th West York Militia.
Crichton, Hon. Henry G. L., Captain, 21st Hussars.

ON THE PROGRESS OF BREECH-LOADING SMALL ARMS.

By John Latham, F.S.A.; Hon. Mem. Royal United Service Institution; Assistant Commissioner for Exhibitions of 1862, 1867, and 1873.

On the 6th March, 1865, I had the honour of reading in the Lecture Room of this Institution a short paper on some early breech-loaders; and in this I was able to show that the earliest breech-loading small arms, of which the date can be identified, are of English manufacture, in the year 1537; and I traced the successive stages of development of breech-loading down to the year 1850. In the course of this paper I endeavoured to classify the principles of construction involved, and to define the general lines in which future progress might be expected. The favourable reception which was accorded to this little essay, which has been frequently quoted as a text book on the early history of breech-loading, has emboldened me to offer a short continuation of the subject down to the present time.

The Museum of this Institution is exceptionally rich in specimens of modern breech-loaders; and my original intention was to give a short explanation and notice of the peculiarities of each, but I soon found that this would be impossible within any reasonable limit of time, however useful such a work might be for reference. It would only weary you to give the detail of every plan which has been proposed and abandoned during the last twenty-five years; and I propose, therefore, to notice only such as seem to me to show some novelty of principle or advance in any direction.

At the close of my former paper I made a short classification of the different plans of closing the breech end of the barrel, as far as they had then been developed, and pointed out that, if we regard only the

way in which the aperture is closed, without including the means employed to secure the closing piece, there are in fact only three ways —a plug, or cone; a block, or wedge; or a tap action.

The first division of my former table was that of "chamber-loaders," as distinguished from breech-loaders direct; this distinction has now become obsolete, or rather the detached loading-chamber has been developed into the present cartridge of metal, either simple or compound, often combined with pasteboard or other materials; but in all its forms it is the direct development of the old "chambers for gonnes" which were used four centuries ago for cannon, and adapted to fowling-pieces in the reign of Henry VIII.

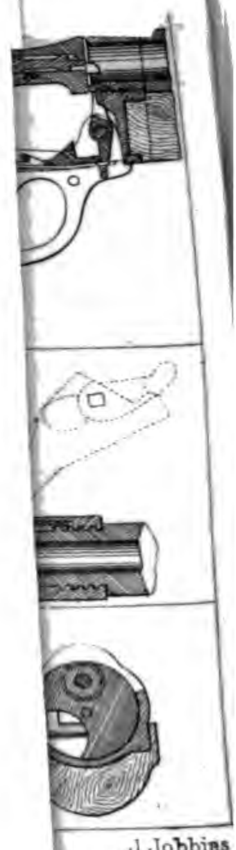
The second division of my table—the loading-chamber attached to the barrel—has passed away for the present; though in the inventions of Mont Storm, Braendlin, and especially the very ingenious plan with a copper cartridge by Captain Selwyn, it gave promise of further development and success.

Among breech-loaders direct, the tap or cross-bolt action, though much improved by Prince and Perry, has died out, and the inherent objections to it are so great, that I do not think it is ever likely to be resuscitated.

The two competing plans are now:—1st. That which closes the breech by a plug or cone. This is generally known as the "*Bolt System*," from the way the plug which closes the breech is advanced between guides, and fastened by a partial turn on its axis, like an ordinary street door bolt. This is the plan generally adopted on the Continent, while the block system in different forms has found most favour in England and America.

In the table accompanying this paper I have arranged the modern plans, into these two main divisions, which are subdivided according to the way in which the closing mechanism is actuated, into eight classes. I have endeavoured to make the table more useful for the purpose of comparison by appending to each name, a figure showing the number of motions required to open, load, close, and fire the arm.

Let us begin with the foremost weapon of the bolt system, the Prussian needle-gun which has been so frequently described and illustrated in the Journal of this Institution, that I need not detain you by any explanation of its mechanism. It belongs to the subdivision *a* of our Table, having a bolt action, with the lock movement contained in the moving bolt. It has been lately the fashion to speak very disparagingly of this arm, which at least, through the events of 1864 and 1866, has been the means of converting the world to a belief in military breech-loaders; but under the name of Prussian needle-gun, we are really considering a whole series of arms. Its inventor, Herr Dreyse, never ceased to improve and alter the original mechanism; and just before his death, had succeeded in adapting it for the metal cartridge, which experience has shown to be a necessity for any breech-loader. It is the parent of the Chassepôt, Beaumont, the Mauser, the Vetterlin, and a host of other modern plans, and the most questionable part of its mechanism, the spiral mainspring, has been adopted in the Martini-Henry. In accuracy of shooting it was of necessity defective, as long



J.Jobbins

as the "self-consuming" cartridge was retained; but at the date of its introduction, its accuracy was far beyond any of the military arms then in use; and for ease of loading, in all positions, and simplicity of manufacture, it is still unsurpassed. I have here a Prussian needle-gun which has been in my possession since 1845, specimens of cartridges, bullets, and sabots with contained ignition of the same date, and a target made with this gun and ammunition last Wednesday, after thirty years' keeping. This may be interesting as illustrating that some ammunition does not necessarily deteriorate with age.

We may now take as the type of the block system a breech-loader (Sharp's) which was submitted to the Board of Ordnance at Washington in 1850. This has a sliding block moved by the action of the trigger guard; the edge of the block was sharpened, and as it rose to its place in closing the arm, it cut off the end of a paper or linen cartridge previously inserted in the barrel. Some of these arms were issued to our cavalry regiments during the Crimean war, and it was found that the escape at the breech was very great, and that as the barrel fouled, the cartridge was impeded in its entrance into the breech, so that the sliding block cut away more and more of the powder as the gun grew dirty. Not only this, but if any grains of loose powder were left about the breech action, which was generally the case, these were ignited by the explosion of the cap, and flashed up in the face of the shooter; so in spite of the great strength and soundness of the action and its facility of manipulation, this gun was condemned through the defects of the cartridge. At the present time, as improved and adapted for the metallic cartridge in the "Henry" breech-loader, it is one of the best of the modern systems.

But both these plans and every other up to 1861 had a very unpleasant peculiarity, viz., that after a little use they were apt to become not only breech-loading, but also breech-firing weapons, the escape of gas at the breech being so great as to hinder anything like steady shooting with them. About this date, however, several plans of breech-loading carbines were issued to the cavalry for purposes of experiment, among which were Green's, a very simple and effective bolt action—Terry's and Westley Richards' plunger-bolt action. With all these, the ordinary nipple and percussion cap of extra strength to enable it to pierce the paper of cartridge were used, but a great advance was made in the cartridge itself by the introduction of a soft felt wad at the base, which acted as a washer to prevent the escape of gas, and also to some extent as a recoil check. After firing, this wad was forced through the barrel in front of the next bullet, thus wiping out the rifle at every discharge. Whilst this contrivance reduced the escape of gas and fouling of the barrel, it was liable to interfere with the accuracy of the flight of the bullet; but in many places where metal or pasteboard cartridge-cases are difficult to be procured, it is still in use for sporting arms.

In 1864 the English Government issued a circular inviting plans for the conversion of the Enfield rifle into a breech-loader. Of about fifty submitted, eight were selected for trial, of which five employed the copper cap and ordinary nipple, and three had pasteboard cartridges

with metal case containing the ignition. Two of these were rejected as unsuitable or dangerous, and the Snider remained the only representative of the central-fire cartridge now universally adopted, but which was then just coming into use for sporting arms.

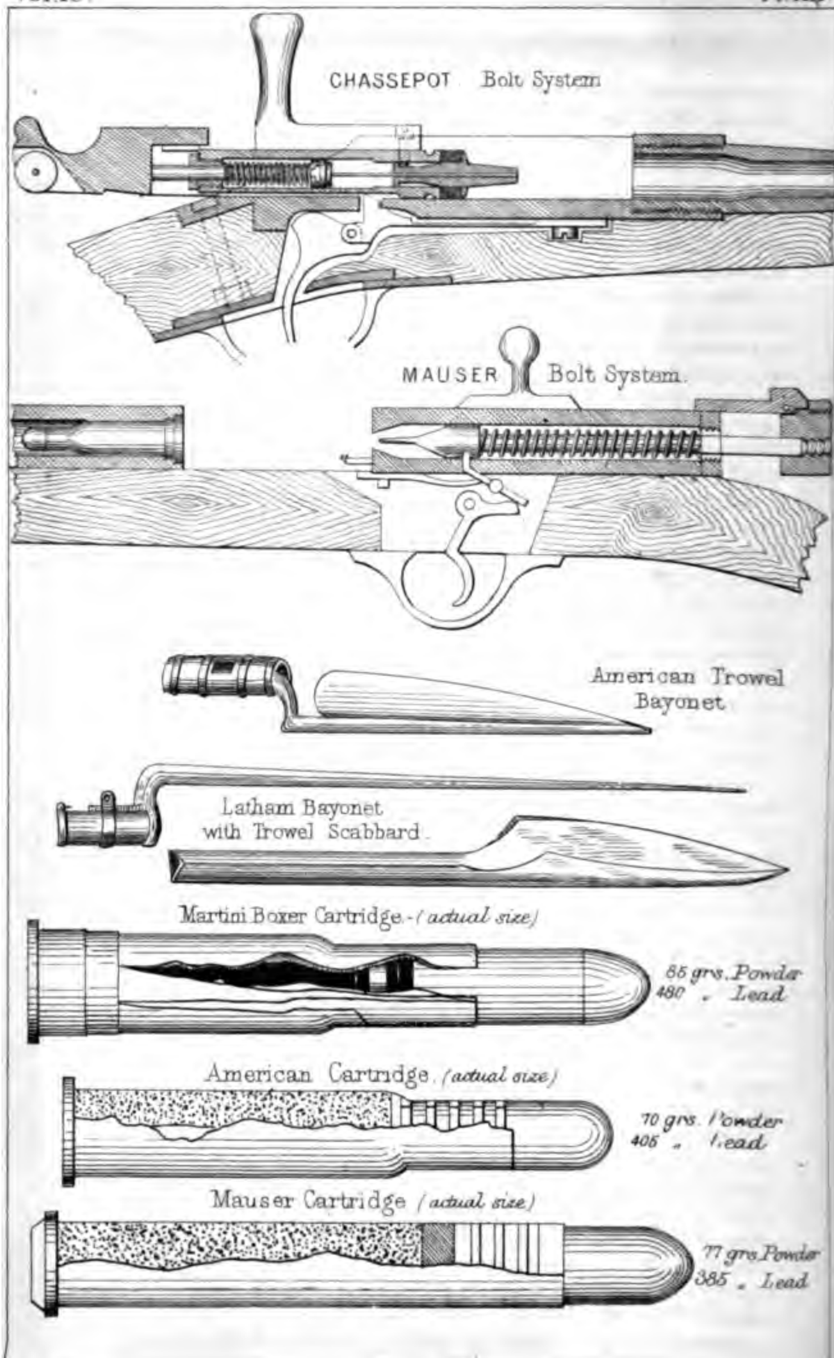
The mechanism of the Snider, which was finally selected, is precisely that of the earliest known breech-loading small arm, of which a very fine specimen in the Tower of London bears the date of manufacture, 1537. If you look at the sketch you will see that the method of opening and closing the breech-block is identical in these two plans, and the iron-loading chamber of the earlier arm is the precise equivalent of the metal cartridge of the present one. The Snider arm was submitted with the pasteboard cartridge with metallic base, which is still used for sporting purposes; but this was found unsuitable in many respects for a military weapon. The pasteboard would swell in damp weather, and split if too dry; and it had not sufficient strength to resist the heavy strain of the elongated projectile. Colonel Boxer, superintendent of the Royal Laboratory at Woolwich, devised a plan of metallic cartridge, to which the success of the Snider is chiefly attributable. Instead of pasteboard, he used a coil of thin sheet-metal, overlapping at the edges so as to expand with the force of the explosion, and fill the chamber, whilst the slight contraction on cooling would allow it to be easily extracted. The cartridge was withdrawn by a separate movement of drawing back the open breech-block to which a short claw was attached, and the gun required to be thrown over on its side to allow the extracted case to fall out.

This additional movement of extraction, however, was so much time lost, and, in fact, neutralised the saving effected by the abolition of the capping movement, and the Snider is therefore a six-motion breech-loader, the movements being, cocked, opened, loaded, closed, fired, and cartridge-case extracted.

But for this defect, the Snider action, which is one of the best and soundest known, would, I believe, hold its own against any of the later systems, especially for large bores and heavy charges. The French adopted this plan largely for the conversion of their old muzzle-loading muskets of twelve gauge, and gave it the nickname of the "Fusil à tabatière"—the snuff-box gun—from the resemblance of the movement to the opening and shutting of a snuff-box. It has been largely adopted as a transition-arm by the Turkish, Dutch, Portuguese, and Russian Governments.

An interesting specimen in the Museum of this Institution (Hunt's patent) shows a very excellent spring extractor adapted to the Snider, which ejects the cartridge-case by the opening of the breech-block without a separate movement; and, with this addition the Snider can be easily made a five-motion arm.

The Belgian Government adopted, in 1867, a plan known as the Brandlein-Albini, in which a hinged breech-block turns on an axis above the barrel instead of at the side, resembling, in appearance, the Mont Storm chamber-loader. A jointed bolt attached to the hammer serves to impel the striking-pin against the cartridge, and, at the same time, locks the breech-action firmly in its place, and the cartridge


CHASSEPOT Bolt System
MAUSER Bolt System.
American Trowel Bayonet.
Latham Bayonet with Trowel Scabbard.
Martini Boxer Cartridge.-(actual size)
85 grs. Powder
480 " Lead
American Cartridge. (actual size)
70 grs. Powder
405 " Lead
Mauser Cartridge (actual size)
77 grs Powder
385 " Lead

J. Jobbins

is extracted by two short claws which are thrown forward by the movement of the breech-block on its axis.

The American Government decided upon a plan for the conversion of their muzzle-loaders, which is known as the Springfield system, and may be described as a combination of the Braendlein and Snider plans, having the movement of the first with the striking arrangement of the second. It is illustrated in section in the drawings, and I shall have occasion to speak of it more particularly further on.

The tests applied to the Snider system to ascertain its powers of sustaining rough usage were very severe, comprising dusting the action with sand, drenching with water, rusting for a week in the open air, firing 500 rounds without cleaning and with cartridges purposely weakened and made defective ; all of which, as well as the further test of time and clumsy usage, it has triumphantly withstood. The Braendlein and Springfield systems have stood an equally severe trial.

In the meantime, the French had improved the Prussian needle-gun, retaining the bolt action and general features of the mechanism, but adding a more convenient thumb-piece for cocking, a secure half-cock to enable it to be carried when loaded, and an india-rubber washer, to prevent the escape of gas. The cartridge was on the so-called "self-consuming" plan, having a linen envelope, and made strong enough to stand rough usage much better than the paper. But experience has shown that no cartridge can be trusted to consume entirely in the barrel, under all circumstances—the metal conveys the heat away so rapidly as often to preserve the thin paper in contact with it from the combustion of the powder.

The Chassepôt Rifle has a steel barrel, with a small bore ·435", a heavy powder charge, 85 grains, and a light bullet, 380 grains. It, therefore, leaves the barrel with a very high velocity, but the bullet is too light to retain this advantage for any great distance, and in the trials made in this country, its shooting was decidedly inferior to that of the Snider. It is said to have an effective range of 1,800 yards, and is a five-motion gun, viz., cocked, opened, loaded, closed, fired.

This was then the condition of matters at the close of 1867. Nearly every European country, with the exception of France and Germany, had adopted some form of the hinged-block system, as a temporary expedient for converting their muzzle-loading arms; in almost every case retaining the old lock and hammer (five-motion plans). The experience of daily use, however, brought out minor defects and difficulties. The breech systems worked well and soundly, but the difficulties clustered around the cartridge and extractor. We began to perceive that the action of the exploding powder in a metal case resembled the effect of a "swedge," and drove the metal into such close contact with the chamber that it was as it were riveted to its place, and occasionally a cartridge would hold in so firmly as to defy the extractor. To obviate this, the cartridges were made more or less conical; they were encased in a paper envelope, which was waxed or lubricated, but without overcoming the evil. It was principally this difficulty which attracted attention to a plan of breech action, inven-

by Mr. Peabody, of Boston, Mass., U.S.A., and patented in England in 1862, and in fuller detail in 1865.

This is generally known as the falling-block system. The action of the breech-block is similar to that of the knuckle-joint of the human hand, and when I bend my fingers towards the palm and then straighten them, the bones move precisely as the block of the Peabody Rifle moves in its morticed seat. In the section shown, I have purposely omitted the firing apparatus, so as to render the breech movement and the action of the extractor more clear. The block moves on an axis above and at right angles with the bore of the barrel, and is actuated by a long lever moving on a centre behind the trigger-guard. As the lever turns, its shorter arm draws the block in a downward direction; from which movement this plan is generally known as the "falling-block" system. From the circular direction in which it moves, the pressure on the base of the cartridge is instantly relieved, and the liability to jam from expansion of the base of the cartridge, which sometimes occurs in the sliding-block system, is obviated. The recoil is received only on the recess of the knuckle-joint, and the pin on which the block turns has no strain upon it, except in the case of a defective cartridge, and friction is reduced to a minimum, as the block comes in contact with the barrel only at the moment of closing.

The great strength, simplicity, and handiness of this movement recommend it at first sight, but the extractor is so especially adapted to the requirements of a metallic cartridge that this has been, I think, one of the principal causes of the favour with which this plan has been received. You will see that, while the first blow of the falling-block on the bent extractor-lever starts the cartridge-case from its hold in the barrel, the further descent of the lever acts with increasing velocity to the end, and expels the empty cartridge-case with sufficient force to cause it to fly up the loading groove, without any assistance from the shooter. To use a rough illustration, it begins with a push and ends with a kick, and some such double movement has been found necessary to overcome the bite of a cartridge-case which has been fired with a heavy charge in a small bore.

By a small bore we now understand any barrel whose calibre is less than ·5 = half-an-inch, a size which, thirty years ago, was considered in England only fit for a pop-gun or toy rifle. We prided ourselves on having the heaviest arm, with the largest barrel, of any nation in the world. The old Brown Bess, or smooth-bore musket, was 12 gauge, equal to ·75 inch, and it is said this bore was fixed on the dictum of the great Duke of Wellington, that thus we could always use the ammunition of any other country, whilst they could not get our large bullet down a smaller barrel. You may judge from this that accuracy of shooting was not much considered. In fact, Brown Bess with the service cartridge was not of much use beyond 50 yards.

In the Minié Rifle which succeeded it, and the bore of which was 14, with a conical projectile and iron cup in the base, we had one of the most effective weapons at short ranges ever introduced, but, as the advantages of accuracy were beginning to be considered paramount, it was abandoned for the Enfield Rifle, having a bore of ·577 and a

turn in the rifling of 6 feet 6 inches, equal to half-a-turn in the length of barrel. This was effective, as a muzzle-loader, up to 900 yards, and when converted to a breech-loader, on the Snider system, to 1,200 yards.

In 1856, Lord Hardinge, then Commander-in-Chief, invited Mr., now Sir Joseph Whitworth, to investigate the laws and properties of rifled arms and their projectiles, and the result of his investigations was—

1. The best form of rifling is that of a polygon; by preference, a hexagon, which admits of the employment of projectiles of different lengths, densities, and shapes, and of any material from soft lead to steel, the projectile being fitted to the form of the rifling; but expanding bullets can be fired from the same barrel.

2. For an ordinary military barrel, 39 inches long, the bore should be ·45 inch, with one turn in 20 inches, which is sufficient for a range of 2,000 yards. The gun responds to every increase of charge, by giving better elevation, from 70 grains up to 120 grains, when the recoil becomes more than the shoulder can bear, with the weight of the service musket.

3. With all expanding bullets proper powder must be employed. A slowly igniting powder is desirable for a hard metal projectile, but with a soft metal expanding projectile, a quickly igniting powder is requisite.

I have given these statements, as nearly as possible, in Sir Joseph's own words, as we shall see that every further experience confirms the accuracy of them, and I am convinced we are only beginning to understand their full application.

The Whitworth rifle was one of the most remarkable strides ever made in projectile science. Its performance with the hexagonal bullet had never been equalled or even approached by any previous weapon, but the mechanically fitting bullet was found to be unsuitable for quick loading from the muzzle; and Mr. Alexander Henry, of Edinburgh, introduced a plan of rifling, based on the Whitworth principle, but more suited for an expanding projectile, in which the corners of the polygon, to which he gives seven sides, are filled up with a projecting tooth extending to the original diameter of the barrel, so that the projectile at its first expansion, is grasped by fourteen surfaces or points of direction. This is the plan now generally adopted for breech-loading rifles.

But the difficulty of combining the mechanically fitting projectile with the mechanism of breech-loading, has been lately overcome by Sir Joseph Whitworth, by the employment of a metal cartridge, the fore part of which containing the bullet, is hexagonal in shape, the after part being of the usual slightly conical form. This can be loaded with the same facility as a circular cartridge, and of course the projectile can be made of any material up to steel itself, as it does not require any expansion to fit the barrel. The terrific force of these projectiles may be seen from the specimens now in the Institution, showing half-inch iron plates completely penetrated by Whitworth steel projectiles at angles of 0°, 35°, 45°, 50°, and 55°.

Many other excellent systems of rifling, the Metford, Rigby, and

Ingram, I am compelled to pass without remark, but one of the latest modifications of rifling, that of Mr. Murphy, introduced by Captain O'Hea, I shall have to mention when I come to speak of the recoil of these arms.

We have now arrived at the year 1868, when a Select Committee was appointed to consider the question of breech-loading small arms, with a view to replace the Snider (which, you may remember, was only the Enfield barrel converted) by a rifle embodying the smaller bore and quicker twist, which Whitworth had proved to be so much superior. In response to an advertisement, a large number of arms were collected and examined, and after a preliminary trial ten were selected. Of these plans, four—the Kerr, Wilson, Carter-Edwards, and Bacon—were on the bolt system, and the Henry, Berdan, Money-Walker, Martini, and two systems by Westley Richards represented the block. During the trials which were purposely made with defective cartridges, two of the bolt systems exploded prematurely, and the others showed signs of weakness, which induced the Committee to reject this principle altogether, as dangerous.

When, as in all bolt guns, the mechanism employed to guide the capped cartridge into its place, has the same movement as the mechanism which fires it, there is always danger, especially in a barrel heated by firing, that a very sensitive or projecting cap may be exploded prematurely; and in such a case, the bolt action which works nearly in a direct line with the eye of the shooter in aiming, is undoubtedly the most dangerous. In the block system any accidental explosion is directed upwards as well as backwards, and would go over the shooter's head instead of towards it.

The further competition was, therefore, restricted to the block systems. After the exposure, endurance, and rusting tests, these were reduced to the Henry (sliding block), and Martini (falling block). They were equal in safety and strength, and the Henry far surpassed the Martini in accuracy, but the Martini was a self-cocking arm, and consequently required one motion less to load and fire than the Henry. A prejudice is generally strongest when it is on the point of collapse, and precisely as the former Committee chose the cartridge with contained ignition, when "everybody" thought it too dangerous for a military arm, so this Committee chose the self-cocking mechanism which everybody, *except those who had witnessed the trials*, thought would be too dangerous for adoption. I think we are all too apt to form opinions, and then look out for facts to support them, instead of taking the facts first, and I must confess that my old prejudice against a self-cocking arm, has not survived the experience of the last four years. It is still a moot point, however, and the Americans have only just, after a careful trial, decided to retain their five-motion Springfield plan, which requires to be cocked as a separate movement.

A specimen of the Henry five-motion side-lock breech action on the plan tried by the Committee is in the Museum of this Institution, and by the kindness of Mr. Henry, I am able to place beside it one of his new self-cocking military breech-loaders, which is also illustrated by a sectional drawing. You will see at once the compactness of this action

and the ease with which it works as compared with the Martini. The straight line in which the extractor moves allows a cartridge of any length to be used, and the facility of cleaning from breech to muzzle, so as to push the dirt away from instead of into the breech action.

So the Committee took the Henry barrel, which was the best before them, and the Martini breech action, and proceeded to adapt them to each other. There was no difficulty with the barrel which performed equally well with any breech action, but their difficulties began in the adaptation, and the cartridge, as usual, was the first difficulty. The bore of the barrel was ·45-inch, and to hold the necessary charge of powder, had to be made 3⅞ inches long, including the bullet. This great length was of no importance in the Henry sliding block action, in which the cartridge case is ejected in the direct line of the barrel, but in the Martini the case has to be propelled up the curved surface of the breech block, and the whole action had to be made so long as to materially increase the weight of the weapon. To lessen this, the cartridge was made bottle shaped, having at the base the old Snider diameter of ·577-inch, and contracting to ·45-inch in front, to embrace the bullet. This enabled the breech action to be shortened and some weight saved, and before finally adopting the gun, 200 were issued for experimental service in all parts of the world. Miss-fires, at first frequent, were remedied by increasing the force of the mainspring from 26 lbs. to 40 lbs. The paper cover of the brass-coiled cartridge was dispensed with, and minor alterations were made in the stock; form of strikers, &c. Finally, the weight of the gun was reduced from 9 lbs. 7 oz. to 8 lbs. 12 oz., which is lighter than the long Snider rifle. It is, however, six inches shorter in the barrel, and is, I believe, shorter than any other infantry arm now in use.

The mechanism of the Martini breech-action is shown in the sectional drawing before you. It is in substance the Peabody, but a very high degree of ingenuity has been employed to make it into a self-cocking arm, with the lock contained in the falling block. The striking pin is moved by a spiral spring, which is drawn back by the movement of the lever in opening the arm. The tumbler is held by a tumbler rest and sear, which retain it at full cock when the breech is closed. This tumbler works on the same axis as the lever which moves the breech block and the full pressure of the spring, until it is caught by the sear, is bearing on the lever axis. The least failure in the action of the sear and tumbler bent, disables the whole action, and we shall see that a slight derangement of these points, caused the discomfiture of the Martini in the latest official competition, in which it was tested against other plans.

In the present breech action of the Martini as shortened to admit the bottle-shaped cartridge, the force of the spiral mainspring has to be exerted within a space of only ·42 inch, and to get the necessary blow to explode the cap, this spring has to be made of great strength, about 14 lbs. at bearer and 40 lbs. when compressed. This produces a harsh dragging action of the whole mechanism, which is especially unpleasant in use.

I purposely forbear to enter into the vexed question of spiral *versus*

flat mainsprings, except to say that there is no reason why a spira spring, made and tested with the same care that is exercised at Enfield should not do its work as well as any bent mainspring, though it cannot last so long.

The weight of this strong spring upon a tumbler which has to work in so confined a space would be dangerous if the tumbler worked directly into the sear as in the original model of the Martini, which has been known to explode a cartridge by the accidental jarring of the heel-plate on the ground. To prevent this and improve the pull-off by lessening the dead weight on the sear-nose, the tumbler-rest, invented by General Dixon, has been introduced, and has greatly modified this difficulty, though it has not entirely removed it. I have known a variation in the pull-off of more than five lbs. occur in a day's practice, and this is a serious matter at Wimbledon, where the trigger of the rifle may be tested at any moment, and the shooter be disqualified if it is found too light. A very excellent improvement in the trigger by Mr. Edge, (models and drawing of which are before you,) is far more safe than the service arm, and gives a really smooth and regular "pull off." This remedies one very great objection to the Martini action.

There is another point which has been brought prominently forward in connection with the Martini, and has occasioned, perhaps, a greater outcry than any other of its peculiarities. I allude to the very unpleasant recoil of this weapon. There is no doubt this defect exists, and that it is perfectly unnecessary, is proved by an experiment which anyone may try. I can say from personal experience that you may fire a similar bullet and charge of powder to those in the Martini cartridge from the Henry, Tranter, Swinburn, Soper, or half a dozen other breech-actions with far less recoil.

The cause is not far to seek. The Martini is an engineer's gun. By this I mean that it is simply a machine for receiving, firing, and ejecting a cartridge; and whether it has to be screwed in a vice or fired from a machine-rest or from a man's shoulder does not appear to have been considered at all.

In a sporting gun we fit the length, bend, throw-off, and grasp of the hand most carefully to suit the user. Of course such nicety is inadmissible in a military arm, but some approach might have been preserved to the old traditions of gun-making. The Martini is little more than a barrel and breech-action screwed into a rough plank; and an old flint musket of William III is a more comfortable arm to fire from the shoulder. First, in the Martini a solid bolt passing through the stock from the butt to the action directs the whole recoil on to the shoulder without the slight relief generally afforded by the elasticity of the wooden stock. Then the hand of the Martini is so constructed (quite unnecessarily) that it is impossible to get a comfortable grasp of it, and the thumb of the shooter, on which the steadiness of the pull-off so much depends, is thrust up to the sky as if in despair at finding itself so much in the way. The fore end where the left hand should control the upward "kick" (which is distinct from the direct recoil) is made so deep and sharp-edged that it would require the

grasp of a Chimpanzee to hold it firmly; and when the Captain of the Scottish Eight at Wimbledon described the gun as a "miserable malformation," he only did it justice as far as the shape is concerned. But the excellence of its shooting is incontestable. The soldier has now a weapon capable of competing in accuracy with the most expensive match rifles of a few years ago; and, as far as I can learn, the men are generally very fond of their new weapon.

The breech-action is safe and strong, but undoubtedly too complicated; and here I must say a word in explanation. I do not regard the number of parts in any piece of mechanism as necessarily a complication. In fact it frequently simplifies the working of a machine to substitute two pieces for one when a double function has to be performed; but the parts of the Martini are so inter-dependent, and rely so much on their mutual adjustment, that a very slight derangement will throw several points out of gear. Thus after the gun has had some wear and has to be re-assembled after cleaning, we find that if the block be too high, the bearing-surface of the lever has to be altered to adjust it, but if more than one hundredth of an inch is required, a new lever must be fitted, if too low, a hundredth of an inch may be added or a new lever. If the striker is too high or too low, a hundredth must be added or taken off, or a new lever. There are three points in the extractor which may require adjustment or a new extractor. The trigger-nose and bent also require careful adjustment, this is the case in all gun-locks—but the trigger-nose must on no account be shortened as this *affects the loading position of the block;* and, as all sportsmen know, the trigger-nose is the part of all others most liable to be damaged by careless usage.

It is because this complexity is due to the introduction of the spiral mainspring and the cramped position in which it works, that I should be glad to see this arm adapted to the flat mainspring which can easily be done without affecting the real excellencies of the system, the falling block and the powerful extractor.

In 1869 Martini patented a modification of his breech-action, in which he introduced a flat mainspring; and, in 1870, Tranter produced an excellent system of falling-block rifle, which was exhibited at the Wimbledon Meeting of that year, and which is shown in section in the drawing.

The lever is here formed by the trigger-guard, which brings down the falling block and cocks the arm. The mainspring is of the same form as that of an ordinary gun-lock, and when the breech-block is closed, the end of the lever forms a direct vertical prop to support its position in the axis of the barrel, while a projecting lip at the end of the block prevents its being thrown too high; and, at the moment of firing, the striker and striking-pin are bolted by the action of the trigger, so that no accident can occur from the exploded cap being blown back.

About the same time Westley Richards brought out a plan of falling-block mechanism using the ordinary bent mainspring, and giving a direct blow from the hammer-head on to the percussion cap, instead of transmitting the force through a striking-pin. To effect this, the

lever is placed in front and over the trigger-guard, instead of behind it as in the Martini. The hammer works in a hollow in the underside of the breech-block, and the point of it strikes through a small hole in the centre of the block-face on to the cap. This plan has answered perfectly with very heavy charges, and is far more convenient to handle than the Martini.

Another excellent plan of falling-block rifle is the Swinburn, which was very successful in the competitions at Wimbledon last year.

In this plan the external parts of the Martini action are retained, except that the unhandy grasp is modified into a convenient shape, and the trigger is brought half an inch nearer to the finger of the shooter. The hand-lever works behind the trigger-guard as in the Martini, but the internal arrangement is far superior, as the breech-closing, firing, and extracting apparatus are kept carefully distinct, and the friction which is so enormous in the Martini is reduced to a minimum.

Each of these three plans preserves the great advantage of the ordinary arrangement of mainspring and hammer in a gun-lock, viz., the increased velocity with which the hammer-face moves as compared with the travel of the mainspring. In all spiral-spring systems the velocity of the striking-pin is only equal to that of the spring itself, which must therefore be of greatly increased strength to ensure ignition of the cap.

Dr. Thayer has a very simple plan for converting the Martini to a bent mainspring lock like that of an ordinary gun, which he will explain to you personally at the conclusion of my paper.

There is a section of a plan by Zeller on the table, which closely resembles Tranter's, but with the shape of trigger-guard modified, and the substitution of a straight for a bent mainspring.

At Wimbledon, last year, there were three principal prizes open to breech-loaders. The first and most valuable of all, was the Queen's prize, at which only Government-made Martini rifles are used, and the average shooting of the first 46 competitors was at 900 yards, 43·65 per cent. of the highest possible score; and at 1,000 yards, 35·02 per cent.

The Secretary of War's prizes, at 900 yards, are open to all military breech-loaders, and the first 46 men in this competition made 75·72 per cent. of the highest possible score, an improvement of 32 per cent.

In the Henry prizes, open to all military breech-loaders at 1,000 yards, the first 46 men made 66·30 per cent. of the highest possible score, an improvement of 31 per cent.

The rifles used in these open competitions were the Martini, Swinburn, Henry, Metford, and Soper.

The last-named of these rifles, the Soper, is one which combines a very high degree of simplicity and accuracy with the greatest rapidity of any breech-loading arm yet introduced. It is closed by a block turning at the side of the barrel like the Snider, and moved by a short lever on the right side, which can be easily pressed down by the thumb, on this lever being depressed through an angle of only 55 degrees; the breech-block is opened, the striker retracted, the hammer set at

full cock, and the empty case thrown out. It has an excellent extracting and ejecting movement which, like all the rest of the mechanism, is very simple and sound. This rifle has been loaded and fired sixty times in a minute, which far exceeds the performance of any magazine gun. It can easily be fired thirty times a minute with good accuracy, and it took the Bass prize at Wimbledon last year. In any future competitive trials this rifle is sure to take a very high place.

I have said that the principle of bolt guns, though adopted in France and Germany, has been, since its condemnation by the Government in 1868, very little heard of in England. It has been much improved, however, and the last gun on this principle introduced by Mr. Green, who was one of the competitors in the Snider trials, and which he has named the "British Breech-loader" is one of the best plans of the kind I know. It is made as a five-motion breech-loader or as a self-cocking arm (four-motion), and carries a metal cartridge which is very cleverly protected from any chance of accidental explosion in closing the breech.

Curiously enough, whilst we condemn the bolt action in England, we find that both the falling block, and sliding block systems, in fact all plans working by means of a lever descending below the line of the trigger guard, have been just as summarily condemned in France and Germany, for this reason, that when, in skirmishing, the soldier is concealed by only a shallow cover, such as a slight ridge of earth, or dry ditch, he cannot make the necessary movement to load and fire without exposing himself more than with the bolt or hinged-block plans, since he must move the rifle from his shoulder to load, and it is argued that as the majority of shots in all future warfare will be fired from under cover, this is an important matter. No doubt it has received full consideration on the part of our authorities, and the commissions which have considered the subject, though I do not find any notice of it in their published deliberations. I only mention it as one of the many points in which the soldier should control the mechanician in devising an arm for military service.

In 1872 a board of officers was appointed to select a breech system for the military service of the United States. Ninety-nine arms were received and experimented upon by them, among which were the Berdan (Russian), Needle Gun (Prussian) Chassepôt (French), Martini Henry (English), Mauser (German), Werndl (Austrian), Werder (Bavarian) and Vetterlin (Swiss magazine musket). Thus the whole of the principal systems in use in Europe were represented, as well as the American plans, and the competition may fairly be considered an international one. Before proceeding to state the results of it, I may briefly describe those arms which we have not before considered, and of which there are specimens on the table before you.

The Berdan (Russian) is a hinged-block gun having five motions, viz.:—cocked, opened, loaded, closed, and fired; has a spiral mainspring, with extractor and ejector adapted for the solid metal cartridge which Colonel Berdan was the first to introduce. It is a thoroughly sound, solid and efficient weapon.

The Werndl, used by the Austrian Army, introduces us to a novel motion on the block system. It has a rotating block turning on an axis parallel with and underneath the centre of the barrel instead of at the side. This block being turned one quarter round on its axis brings a cylindrical groove opposite the end of the barrel, through which the cartridge is inserted—by reversing the movement of the block, the breech is closed, and on firing the cartridge is exploded by an oblique centre pin struck by an ordinary percussion lock and hammer.

The Vetterlin (Swiss magazine musket) is of formidable weight, especially when charged. It uses a bottle-necked rim-fire cartridge of small capacity, and has three motions as a magazine gun and four when used as a single loader, viz., opened, *loaded*, closed and fired. If the cartridge is drawn from the magazine, of course the loading movement is saved.

The action is on the bolt principle and similar to that of the needle-gun. Drawing back the bolt, compresses and cocks a spiral main-spring, and the cartridge when used as a single loader, is inserted and guided into its place by reversing the movement of the bolt in the usual way. But when the magazine of cartridges contained in a tube under the barrel is put into communication with the breech action, the movement of opening the bolt, throws up a carrier containing a cartridge, which is guided into the barrel on closing the arm.

The Remington rifle which is a great favourite in America, and is used in the Swedish, Spanish and other armies, is closed by a block forming a segment of a circle, and turning on an axis below the barrel. This is locked by a second block turning on a lower axis, and the combination of these two blocks resists the backward force of the explosion. It is thus a five-motion breech-loader, requiring a separate cocking movement. The mechanism at first sight does not give the idea of sufficient strength to resist a heavy charge, but in no case has it failed to stand the severest tests, and it has actually been fired with the enormous charge of 750 grains of powder and 40 bullets, occupying the whole length of the barrel.

The Mauser, which is the latest modification of the bolt system adopted by the German Government has excited a great deal of interest in England, it being known that this arm was being made in large quantities in this country, and that the manufacturers were bound not to disclose any particulars of its mechanism. My request for information to those gentlemen was met by a very courteous refusal and expression of regret that this was the case. But the Emperor of Germany and King of Prussia having presented a specimen to the Museum, I am now enabled to describe it. The Mauser resembles in appearance both the Prussian needle-gun and the Chassepôt. It is a self-cocking arm, having four motions,—opened, loaded, closed and fired. The opening is effected by raising the handle of the breech-bolt to a vertical position and then drawing it back. This compresses the spiral mainspring and cocks the arm, and the novelty of the action consists in the way this is effected. The breech-bolt is divided into two parts, to the hinder of which the firing pin is attached, while the fore part contains the spiral main-spring.

These parts are joined by two interlocking cam surfaces which move on each other when the bolt is turned round, and separate the parts till the firing pin end is caught by the sear. When the bolt is turned back to its place the firing pin is free to move forward without any resistance from the cam surfaces, whose curves are now opposite to each other, and can enter without friction. A movable frontpiece, called the recoil-block, moves with the bolt, but does not turn with it, and thus serves as a safeguard against accidental discharge, as the pin can only pass through it when the gun is cocked, and the bolt fully home.

This is a strong sound movement which is instantly understood by a soldier accustomed to the needle-gun, but it is a mistake to suppose, as has been asserted, that it is either a better arm than the Martini, or that it is perfectly free from the sources of danger which exist in all bolt guns. The Germans are far too practical and clear sighted to make any such claim for it. In a very complete and elaborate explanation of the Mauser system, by Captain Hentsch, of the Prussian army, published at Berlin in 1872, he concludes by saying that the future of breech-loading belongs to the block system, and that the cylinder (or bolt) movement may be considered as antiquated, and no longer suited to the times. He only claims for the Mauser system that it is certainly the most complete and best construction of its class.[1] I am compelled to join issue with him even there, for I cannot help thinking that this weapon (Green's) does the same work as efficiently with a simpler movement.

The Mauser has a calibre of ·43 inch, is rifled with four circular grooves, and is fired with 77 grains of powder and 385 grains of lead. The bore, bullet, and powder-charge are therefore less than in the Martini, but the arm itself is much heavier, the weight of the rifle being 10 lbs. 8 ozs., and the brass-handled sword-bayonet 1 lb. 10 ozs. additional, without scabbard.

The tests applied by the Washington Board to the arms before them were:—

1st. That for safety each gun should be fired ten rounds by the exhibitor, if present, or else with a lanyard; then with 3 cartridges purposely made defective, and the escape of gas at the breech registered by putting a fresh piece of paper over the breech at each discharge.

2nd. How many shots fired in one minute would strike a target 6×2 feet at 100 feet distance.

3rd. The number of shots which can be fired in one minute irrespective of accuracy.

4th. Endurance. 500 continuous rounds without cleaning.

5th. Dust. The mechanism to be exposed to a fine sand blast for

[1] "Nach dem Obigen kann nun wohl angenommen werden dasz die Zukunft den "Blockverschluessen gehoert, und die Cylinder-verschluesse, das sie von jenen ueber- "fluegelt sind, als veraltet und nicht mehr zeitgemaesz anzusehen sind. Zu diesen "gehoert aber auch das Mauser-System, welches im Uebringen allerdings wohl die "Vollkommenste Construction dieser Gattung ist."

two minutes; removed; fired 20 rounds: sanded again for two minutes, and then fired 20 rounds more.

6th. Rust. The breech mechanism to be cleaned from grease. The barrel greased and plugged, and the butt of the gun immersed to the height of the chamber in salt water or solution of sal-ammoniac for ten minutes, exposed to the open air for two days, and then fired 20 rounds.

7th. Excessive charges. To be fired once with 85 grains of powder and 450 grains of lead, and once with 90 grains and 450 lead, and once with 90 grains and 900 grains of lead.

One very fair provision was, that any cartridge missing fire should be tested, to ascertain the cause of failure, whether in the gun or ammunition; and it will be noticed that the first of the excessive charges used as a test is actually lighter than the service charge of the Martini. The arms which survived these preliminary tests were subjected to a further series of supplementary trials, as follows:—

1st. To be fired with two defective cartridges, then dusted five minutes. The mechanism being at half-cock then fired six shots, the last two with defective cartridges; then, without cleaning, to be dusted with the breech fully open, and fired four shots.

2nd. To be rusted for four days, after immersion, as before, and then fired five rounds with service cartridge; then, without cleaning, to be fired five rounds with 120 grains of powder and a ball weighing 1,200 grains; the gun then to stand twenty-four hours without cleaning, then to be thoroughly examined.

It is satisfactory to know that the Martini-Henry "came round the "corner," and was one of those subjected to the supplementary tests with the following result:—

After the first exposure the arm worked stiffly. It pulled off very hard; the extraction was imperfect, the extractor only just starting the case out of the chamber.

The piece would not remain open after the lever was depressed, it was exposed a second time to the dust after which it opened very stiffly; one shot was fired, but in trying it afterwards it was found that the tumbler would follow up the motion of the block in closing.

By much working of the parts they performed their functions more properly, though moving stiffly meanwhile.

But after the second rusting test and exposure for four days, we find the guns opened and worked very stiffly, the tumbler invariably following the movements of the lever in closing. The piece was then dropped as disabled by the rust.

The Werndl, which had accompanied the Martini to this point, was also disabled, and was "dropped" by its side.

From the description, I should judge that this particular Martini rifle was disabled by the rusting of the trigger, or tumbler rest, overcoming the pressure of the trigger-spring, and holding these points permanently in the position of easing springs, as we find that the breech-block movement worked, though stiffly, to the last.

In the final series the guns were reduced to six, viz., the Elliot., Springfield, Remington, Freeman, Peabody, and one magazine musket,

the Ward-Burton, of which there is a drawing in section before you. This gun was also the only representative of the bolt system which had stood the tests, all the others being block guns, the Winchester, a very excellent magazine gun on the block system, having been disabled, like the Martini, by the second rust test.

It was then decided to issue a certain number of four systems, viz., the Remington, Springfield, Sharp's, and Ward-Burton, for trial, to the troops and await their report, when the preference was so markedly given to the Springfield, that the Board recommended that this system be adopted for the United States' Service. They added two other resolutions, that "the Elliot system had exhibited such remarkable facility "of manipulation, in requiring but one hand to work it, that it is "especially adapted to the mounted service, and recommended that a "limited number of carbines on this system should be made and "issued for trial. And further, since, in the opinion of the Board, "the adoption of magazine guns for the military service by all nations "is only a question of time; that whenever an arm shall be devised "which shall be as effective as a single breech-loader, as the best of "the existing single breech-loading arms, and at the same time possess "a safe and easily manipulated magazine, every consideration of "public policy will require its adoption." They added, that they had been so impressed by the merits of the Ward-Burton magazine carbine, as being the best of which they had any knowledge, that they suggested a small number should be made on this plan for trial.

But here a complication arose, which showed that even in the best regulated governments, difficulties will occasionally occur, for the Chief of Ordnance respectfully returns the report to the Secretary of War with this remark, that as the system recommended by the Board was to be "the only one" to be used in future, the law prohibits the manufacture of these two systems for experiment, that is, till the difficulty has been removed by the action of Congress.

The Elliot system, specially recommended for trial by the cavalry, is shown in section in the drawing before you, but I have not unfortunately an example of it, and its action is rather a peculiar one. It is a block action, having four movements, viz., opened, loaded, closed, and fired.

By cocking the hammer it operates as a lever on a stud attached to the breech-block, at each movement alternately pushing and pulling against the lower arm of it—so as to open and close the piece. After it is opened, the hammer falls forward, and resting on the projection prevents any motion of the block until the piece is closed, which is effected by again bringing the hammer to full cock, when it is caught by the trigger, and held ready to fire. When the trigger is pulled, the hammer-head strikes a firing pin, jointed in two sections, and explodes the cap. This action, and that of the Soper, are the only two I know which can be worked by the movements of the fingers and wrist of one hand without moving the fore-arm, and this is a great advantage in a cavalry weapon.

A very neat and handy cavalry carbine, with a sliding block movement, having the lock contained in and moving with the trigger-plate

and guard, has been kindly lent me to show you by Messrs. Deeley and Edge. Though not yet perfected, this is a very neat, handy, and compact weapon. It has only fourteen pieces in the breech mechanism, and of these but two are screws.

In the meantime a separate Board of Ordnance Officers had been sitting to determine the proper calibre for small arms as an appendix to the Report on breech-loading systems. Practically, their investigations were limited to determine whether the American service calibre of half-an-inch should be reduced, and if so, how much.

The calibre tried in these experiments were 50″, 45″, 42″, and 40″, and their decision, was, that the calibre of 45″ was the best. It is curious to recollect that this is the precise calibre recommended by Sir Joseph Whitworth in 1857; that, in 1859, a Committee of Officers reported that it was too small for use as a military weapon; and then, in 1869, that another Committee reported, that this identical size was the most suitable for a military arm.

In the American experiments, the same European arms were tried in competition as were used by the Breech Action Committee, and it is satisfactory to read that "the only foreign system that shows "no deterioration of practice in 100 rounds is the Martini-Henry. "The worst is the Austrian Werndl, which goes completely wild after "sixty shots."

The barrel finally adopted has a bore of ·45″, three plain grooves, equal in width to bands, an uniform depth of 005″; twist uniform, 22″, weight of barrel, 3 lbs. 9 oz., weight of gun, 9 lbs. 1½ oz.

The ammunition has a solid conical copper case, firing 70 grains of powder, and a hardened bullet of 405 grains weight. Total length, 2·6″; total weight, 604 grains. The Martini cartridge tried with it, and to which these remarks refer, had a total length of 3·15″, and a weight of 767 grains.

In comparing them, the Committee made the following remarks after stating that at 500 yards—

The ·45″ Springfield, 70 grains of powder, 405 grains lead hardened penetrates 8′ 8″ into pine boards.

The ·45″ Martini-Henry, 85 grains of powder. 484 grains lead hardened penetrates 11′ 2″ at the same distance.

"It appears that the ·45″ (American gun) gives the greatest "penetration of any experimental system tried; the additional 2′ 4″ "of the Martini-Henry being gained by 15 grains more powder, and "80 grains more lead.

"The absolute practical recoil of an arm is difficult of determina- "tion. Reliable comparative recoils are however obtained by allow- "ing the butt to rest against a coiled spring with a proper index.

The following were so obtained:

·45″ (Springfield) 123·6 pounds.
·45″ (Martini-Henry) 139·3 pounds.

"The Board was inclined to attach considerable importance to dimi- "nished recoil, deeming that refinements of action in other directions "are largely thrown away, if there is to be any flinching in the "soldier who pulls the trigger.

"In its view the additional 2·4" inches of penetration, at 500 yards "of the Martini-Henry, is too dearly bought at 16 pounds increased "recoil, leaving out of consideration the much heavier ammunition.

"Forty rounds of each of the following cartridges weigh—

·45" Springfield, 3 lbs. 7 oz.
·45" Martini-Henry, 4 lbs. 6 oz.

"Thus 51 rounds of the American ammunition could be carried at "less weight than 40 rounds of the only foreign ammunition whose "performance assimilates to it, viz., the Martini-Henry."

At the longest ranges, the results of five targets, at 500 yards, were:

	Springfield.		Martini-Henry.	
Mean	800 yards.	1,050 yards.	800 yards.	1,050 yards.
Absolute deviation	23′ 3	35′ 2"	20′ 5"	33′ 7"
Angle of sight	2° 27′ 16"	3° 34′ 15"	2° 27′ 38"	3° 26′ 43"

With regard to the question of bottle-shaped cartridges as distinguished from straight or regularly conical ones, the Committee directed some experiments to ascertain the difference of pressure in communicating equal velocities.

They found that for every hundred feet of velocity impressed, the bottle-shaped chamber had to sustain a pressure of 1,402 lbs. per square inch, the pressure on the straight chamber being only 1,254 lbs., a difference of 148 lbs. Now, when the question of the recoil, which has been so much complained of in the Martini, is considered, we must not overlook how much of it is due to the peculiar shape of the cartridge. The base of the American cartridge is ·5, that of the Martini nearly ·6, and consequently the area from which the direct recoil is transmitted is so much larger.

So that everything in the Martini, shape of stock, construction of breech-bolt, and shape of cartridge, combines to increase the recoil, and the *Field* newspaper stated last month on "reliable information," that of these rifles already issued, from 5 to 7 per cent. are always in the hands of the armourer, chiefly from broken tumblers and springs. If there is any truth in these figures, it is high time the pattern was altered.

But, of course, a recoil to some extent must exist in all fire arms. What means have been contrived to lessen it? First, Mr. Murphy's plan, submitted by Captain O'Hea, which consists in removing the rifling from the seat of the shot to within about six inches of the muzzle, and shaping the junction of the so formed smooth bore with the rifling, according to the system which has been explained at this Institution by Captain O'Hea himself. This has undoubtedly given, in many instances, greatly diminished elevation and recoil, combined with increased accuracy; and it is certainly desirable that a more extended trial should be made of a system which has given such very promising results. In the only gun which the Government tried on

this principle, the gain in corrected elevation, after the alteration, was at 500 yards, 7′ 55″; at 800 yards, 9′ 0″; and at 1,000 yards, 11′ 50″.

Another plan which has been proposed to lessen the recoil, by Lt.-Col. Silver, of the Essex Volunteers, is to fit on to the butt end of stock a heel-plate of vulcanised rubber of varying degrees of hardness. This is undoubtedly most effectual in absorbing the recoil, and if it is found to have sufficient durability to stand the rough work of a campaign, we may look forward to see Sir Joseph Whitworth's anticipations realized, and be able to fire steel projectiles at 2,000 yards with 120 grains of powder. In a sporting express rifle I have fired 155 grains of powder ($5\frac{1}{2}$ drachms) without any unpleasant recoil.

Amongst the arms presented to the Board at Washington, there were some specimens of an attempt to combine a spade—or rather trowel—to be used as an intrenching tool in place of the bayonet. These trowel bayonets, as they were termed, were at first laughed at as mere toys, the President of the Committee expressly states so in his report, but the first experiments tried with them, proved their value so fully that it was resolved to make a special report on the subject, and here are some of the results:—At the first trial, three men—labourers—in 4 minutes, 30 seconds, threw up an embankment 20 inches high, 30 inches wide at the base, and about 8 inches wide at the top, and $5\frac{1}{2}$ feet long, which concealed them from observation at a distance of 10 yards when they lay down on the ground. The bayonet shank having been found inconvenient to hold, was fitted with a removable wooden handle, with which a better result was produced, a similar embankment having been thrown up in 4 minutes, and on a second trial in 2 minutes, 45 seconds. The President says, "I am satisfied "that troops provided with it can completely shelter themselves "from musketry fire in a few minutes. So shelter themselves, that "with good breech-loading arms their position will be nearly impreg-"nable."

The Colonel of Ordnance, who writes next, endorses the value of the trowel, but suggests that it should be carried separately, for fear it should injure the gun, which, as he justly observes, is the most valuable tool of the two.

The Colonel of Infantry follows the opinion of the Ordnance Officer, especially insisting that the present triangular bayonet shall be retained. The unanimous decision of the Committee is, that something of the kind shall be adopted, and ultimately it is resolved to issue for trial 10,000 of these trowel bayonets and an equal number of intrenching tools, to be carried separately and tested against them.

Whilst copying the resolutions I have just read you, only a few days ago, it occurred to me that if it were possible to combine a light steel scabbard for the bayonet, with the trowel fixed at the end of it, several of these objections, especially that of weight, would be considerably modified if not done away with, while the triangular bayonet would be retained in its full efficiency as the best thrusting weapon ever devised for troops. I have only had time to make up a very rough model of this dea, which I have here for your inspection, and

I think it is sufficient to prove that we may, by the addition of a steel trowel scabbard weighing less than 10 ounces, to the present bayonet, not only convert it into an efficient intrenching tool, but preserve its full value as a weapon. The trowel can be put on and drawn off in an instant. I have also had it fitted into a frog, that you may judge how far the appearance of the soldier's accoutrement is affected, and I think you will say—very little. The extra weight of trowel and frog, as compared with present bayonet scabbard and frog, is four ounces; and this would have, of course, to be saved in some way from the soldier's equipment, if the plan were adopted. As this contrivance has been made up in the greatest hurry, and indeed only completed an hour since, I must ask you to excuse the rough state of the pattern before you, which I hope you will think of sufficient interest to warrant my introducing it.

In concluding this rapid and imperfect survey of the state of breech-loading at the present time, I hope I have made clear, as I have endeavoured to do, how closely these three questions are dependent on each other, and I place them in the order of their importance.

1. The cartridge;
2. The barrel;
3. The breech action.

Having obtained a good cartridge, we may find half-a-dozen plans of rifling and a dozen plans of breech action, with which it will perform well. But the first question is—What do we really want? Sir Joseph Whitworth, whose reasoning is as exact as his mechanical workmanship, tells us that if we want great range, low trajectory, accuracy, and penetration, we must employ a long bullet, high rotation, and a large powder-charge. Every experiment for 16 years proves the truth of this opinion.

But in America we find a Committee of Officers, after a long course of experiments, decide upon a lighter bullet and less powder-charge, because of the saving of weight to the soldier. Now, shall we ever be able to make clear to ourselves what we really do want? or how to compensate these conflicting interests? Is the value of increased accuracy of shooting, at distances beyond 800 yards, worth an increase in the weight of the arm and ammunition? When we watch the marvellous shooting for the Elcho Shield at Wimbledon—when the same man will drop bullet after bullet within the space of a man's hand, at 1,000 yards, we see what can be done by the best marksmen, with the best weapons; but, at this very Wimbledon meeting, what will be the average shooting, with these same weapons, through the whole meeting? Why, at 800 yards, only one out of six shots will hit within a circle of 20 inches in diameter, and in all probability, in the field, this would not even be approached.

When we have decided upon the best cartridge, which, as we have seen, depends upon the distance we want it to shoot, it will be worth while to consider whether it is absolutely necessary that we should have only one form of breech action for the service, and whether the peculiar exigencies of the infantry, cavalry, navy, and artillery might not be easily consulted by a modification of the arm, providing that

the same bore and cartridge were employed, but, if necessary, with varying lengths of powder-charge and bullet.

Lest it be objected that I criticise much and suggest nothing definite, I will give a slight sketch of what are the principles which I think should guide us in selecting a military breech-loading small arm. For the barrel, let us take that which shall make the best aggregate shooting at 300, 600, and 900 yards, and we shall have a weapon which will give all the accuracy that the average human eyesight can employ; the weight of gun not to exceed 9 lbs, without bayonet, which is the utmost that can be handled or carried with comfort, the lightest cartridge which will stand knocking about, and throw a bullet of 450 to 480 grains. For the breech action, let us choose that which is most easily repaired by a half-skilled workman in a hurry, and away from any manufacturing resources or machinery, as, for instance, on the road to Coomassie.

Let us have a triangular straight bayonet, and if we can, combine with it a light intrenching tool, under three-quarters of a pound in weight, like that I have shown you; it will be most serviceable. Let the sergeants and corporals carry a sword-bayonet, like the Elcho, which combines a bill-hook, hatchet, and saw, instead of the straight bayonet and trowel.

I can only say that no one will be more pleased than myself to see every one of these suggestions contradicted, criticised, and discussed, until each is replaced by something better; but I cannot help thinking that in England lately we are trusting too much to mechanicians and manufacturers upon points which require the special knowledge of a soldier to decide. Only let those who can speak from experience clearly define what is really wanted in a military weapon, and then we may safely rely on the manufacturing skill of England to give us the best realization of their wishes.

Comparative Weights of Service Musket, with 40 rounds of Ammunition.

	Rifle.	Cartridges.	Total.
	lbs. ozs.	lbs. ozs.	lbs. ozs.
English. Martini Henry	8 12	4 6	13 2
American. Springfield	9 1¼	3 7	12 8¼
Russian. Berdan	9 2	3 7	12 9
Austrian. Werndl	9 11	2 14	12 9
Swiss. Vetterlin	10 0	2 10	12 10
Prussian. Mauser	10 8	3 2	13 10

TABLE OF BREECH-LOADING SYSTEMS, 1874.

The figures following the name show the number of motions necessary to load and fire one charge; starting with the breech-action closed, and hammer down.

Chamber Loaders. *Obsolete.*		Tap, or Cross Bolt. *Obsolete.*
Jouband, 6.	Leetch, 6.	Perry, 5.
Harrison, 6.	North, 6.	Mathews, 5.
Needham, 6.	Lechmere, 5.	Leetch, 5.
Rutley, 4.	Mont Storm, 6.	

Plug or Cone—"Bolt Action"—having the Lock mechanism,

Contained.		External.	
s. Sears, 6.	American, 4.	Prince, sliding barrel, 6.	Reeves, 6.
s. Prussian, 6.	*s.* Needham, 4.	Wilson, 6.	W. Richards, 6.
s. Wilson, 4.	*s.* Dreyse impd. 4.	Terry, 6.	Carr, 6.
s. Burton, 4.	*s.* Chassepôt, 5.	Burton, 6.	Cooper, 6.
Millar, 4.	*s.* Mauser, 4.	Green, 6.	Kerr, 5.
Carter Edwards, 4.			

s. Signifies "spiral main-spring."

Block or Wedge Action, viz.—

Falling Block.	*Sliding Block.*	*Segment Block.*
Allen & Weelock, 5.	Sharp, 5.	Perry, 6.
Peabody, 5.	Henry, 1867, 5.	Remington, 5.
Roberts, 5.	Westley Richards, 4.	Comblain, 4.
Elliott, 4.	Ballard, 5.	
Werder, 4.	Cochran, 6.	
Westley Richards, 4.	Henry, 1874, 4.	
Martini, 4.	Deeley, 4.	
Tranter, 4.		
Swinburn, 4.		
Zeller, 4.		

Hinged Block, turning on an axis at the

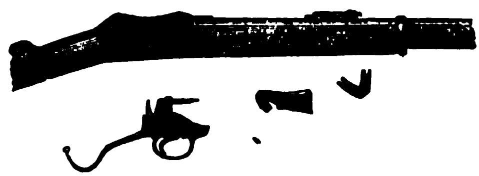
Side,	Under, *or*	Over *the barrel.*
Snider, 6.	Krutsch, 4.	Braendlin, 5.
— Hunt, 5.	Werndl, 5.	Fosbery, 5.
Soper, 4.		Berdan, 5.
Needham, 5.		Springfield, 5.
Joslyn, 5.		Waenzl, 5.
Newark, 6.		Selwyn, 5.

Magazine Guns	Unknown (A.D. 1666).	
	Ball & Lamson.	Scott.
	Spencer.	Selwyn.
	Henry.	Vetterlin.
	Ward Burton.	Winchester.

PROPOSED ALTERATIONS IN THE MARTINI-HENRY RIFLE.

By Dr. L. O. Thayer, M.D.

By the kind permission of the Council of this Institution, I am enabled this evening to bring to your notice what I think to be improvements in the "Martini-Henry" rifle, and I will now proceed to name them in detail, trusting that their simplicity will meet with your approval.



As you perceive, I have removed the spiral spring, and the two bolt-screws necessary to hold the spiral spring in its position in the breech-block, and have removed sufficient of the under surface of the breech-block to admit of the free exit and entrance of the needle or striker. This latter I attach to the head of the tumbler by a small screw, and cut away a sufficient portion of the back of the tumbler, at its lower third, to form a catch for the spring.

The spring is a flat or ribbon spring, bent to a V-shape, placed upright, one end in a slot or niche in the body of the shoe, the other end free and engaging the tumbler, driving it strongly forward when the trigger is pulled, and carrying the needle against the cartridge.

The alterations required in the Martini to admit my improvements are so slight that the expense incurred would be more than counter-balanced by the diminution of parts, and by the gain in time required to take the action to pieces for repairs and cleaning.

The item of repairs alone would justify the adoption by Government of my adaptation, as it is almost impossible for my action to go wrong, or break, from the force of the spring being so applied as that its whole power may be exerted without detriment to any part, or necessitating double pieces, as in the trigger and trigger-rest in the present arm.

The mainspring being flat and loose is not easily broken, pressure is always even, and I feel sure that the tumblers, needles, and spiral springs, now so often found broken in the Martini, will be entirely done away with, and the great expense to Government for repairs to disabled guns and in wages to skilled workmen, dispensed with.

By the use of a flat mainspring, regularity in the pull off is also gained, and any required weight can be placed on the trigger. With the spiral spring this is an impossibility, as was shown at Wimbledon

last year, where the pull off ranged from two to twenty pounds by a slow or quick descent of the lever in ejecting the cartridge.

As to the grasp also, the thumb-rest is rendered unnecessary, as by doing away with the sear-rest, the trigger is brought nearer the shoulder, and the soldier's hand can get well round the gun, and is not kept in an extended position as now.

The cost of a flat mainspring like mine is about the same as that of the spiral spring, and its advantages are so much greater that in my opinion it ought to be at once applied.

This is done so easily that no alteration to the present machinery in use would be needed, which would not be the case if other systems were to be used, as the Westley Richards, Swinburn, Tranter, &c. I have also to add that in lieu of the indicator (which at night, by the way, is no indicator), I substitute a short lever, serving by its length as a rest for the soldier to support arms, when on sentry duty, and also as a safety or half-cocking apparatus, by which he can uncock or cock his rifle without danger, or as now, being obliged to depress his lever and throw out the cartridge, with the risk of losing it in the dark or in the woods. His Royal Highness the Duke of Cambridge has been pleased to express his approbation of my proposed alterations.

It seems very necessary that the soldier should be armed with a weapon on which, from its strength and durability, he can rely, and one which in time of need he can clean, repair, or replace the broken parts of, himself. A spare needle or spring could be easily carried in his knapsack. All the tools requisite for my improved rifle are, a small file and a screwdriver, the file to make a needle from a nail, if necessary, and the screwdriver to take the mechanism out, to clean or to repair it.

These are a few of the advantages to be derived from the improvements now brought before your notice, and I trust that they may be thoroughly tested, and their value proved.

I thank you, Mr. Chairman and Gentlemen, for your kind attention, and shall be happy to answer any questions on this subject.

The CHAIRMAN: There is no half-cock?

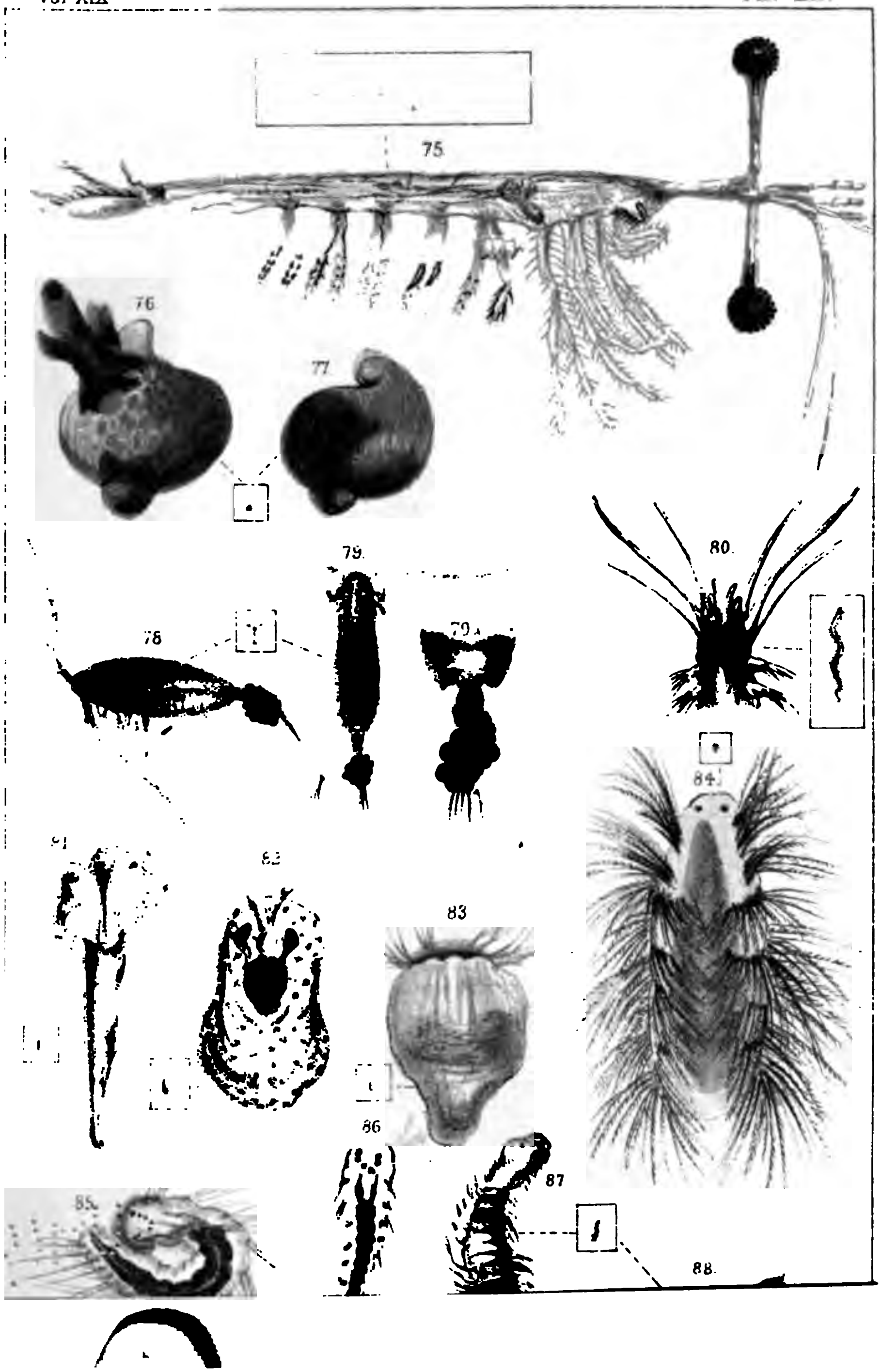
Dr. THAYER: No half-cock, it is the same as in the Martini, and no trigger-rest is required, as the action is direct in the rear, consequently you do away with the pieces that are required in the Martini.

I also wish to show a bolt gun, which I think does away with the main objection to the use of the bolt, viz., the danger of the gun going off when the bolt is in this position, which sometimes happens in the Chassepôt and other guns made on this principle. My improvement is the introduction of a cam, so that the needle cannot strike the cap, and the gun cannot go off until the bolt is right over. This gun only contains 13 pieces including screws, viz., five screws and eight pieces. By removing two screws, the whole action is seen. I saw a gentleman in Paris firing a Chassepôt recently, and the bolt flew backwards, removing the whole of the side of his cheek.

The CHAIRMAN: As no gentleman rises to make any observations, I wish to say a few words before giving that which I am sure will meet with your entire concurrence, our hearty thanks to Mr. Latham for his most interesting paper. I do not know that I have ever listened to any statement of the kind which has been more interesting, more intelligent, or has contained a larger amount of useful information than the paper which we have heard read this evening. In his criticisms and comments on the various forms of breech-action, Mr. Latham has not flinched

from saying what he thought the merits or defects of each, but he has done it in that language which will make it acceptable, I believe, even to those who see the error of what they considered to be the acme of perfection. There are several points, in fact, there are so many points in this most interesting paper which, if all were touched upon, would occupy very much more time than is necessary or desirable to give to the subject now, but there are one or two points which I think we may very safely accept as the result of what we have heard this evening. The first is that one of the great defects of the rifle which has been introduced into our army is that it is not possible to cock and half cock it. To me that has been from the first, the very greatest defect that the mechanism of the rifle possesses. Another point which I consider unnecessarily elaborate, is the rifling. Mr. Henry's rifling has obtained great celebrity in England, and it is, I believe, made the model now by gun-makers who used formerly to apply different systems. But we see the Americans steadily sticking to the old form of three-gouge grooves, and in the face of all that they have seen and proved by experiments, they still adhere to that form of grooving instead of adopting that which we consider to be so excellent; and the shooting of their rifle is really, for military purposes, quite as good as that of our own. Now I am of opinion that the great surface of friction in the Henry form of grooving, is one of the causes of the heating of the barrel. The high pitch of twist is undoubtedly one of the causes of recoil, and the very great surface produced by this system of rifling gives such a large surface for the bullet to rub against, that the barrel heats unnecessarily. Not to enter into detail, I think our Government or any Committee which may be appointed to improve the military arm (and that it does require improvement there is to my apprehension the most undeniable evidence), will find in this admirable paper which Mr. Latham has read to-night, matter which will furnish them with sufficient information on every point as far as I understand it, to enable them to design and bring out a rifle—even if they adhere to the drop block principle—which will be as nearly perfect as it is possible for any machine to be. The form of the cartridge requires modification unquestionably, and the form of breech-action I think requires modification. There are several patterns; I believe a Swiss pattern, the Zeller, appears to possess all the requirements of a drop-breech action, but I must say (and I adhere to it) that with all that has been said against the bolt principle, I still feel that principle to be the handiest; and handiness will in future be one of the greatest requirements of a good rifle. When a soldier is behind a shelter-trench, it will be impossible for him to manipulate well, when he is obliged to lift his body and to move his arm *in extenso* (as he is in all those systems which are moved by a lever underneath), *i.e.*, he cannot be as effective or as well concealed as he would be while using the Soper or the Green, or any of those systems where he can do all that is required by the mechanism of the wrist. I have never deviated from my opinion as to Mr. Green's rifle, which has this one excellence, that you cannot strike the cartridge with the bolt. When the bolt is pushed home as far as you can push it in a straight direction, there is still an eighth of an inch between the front surface and the base of the cartridge. The closing of the breech in Green's breech-loader I consider as safe as it is in any other form of weapon.

And with these remarks I think I may ask you to give our warmest thanks to Mr. Latham for the very admirable paper which he has read to us. I may also be allowed to thank Dr. Thayer for his kindness in exhibiting these his most interesting improvements in the mechanism of rifles.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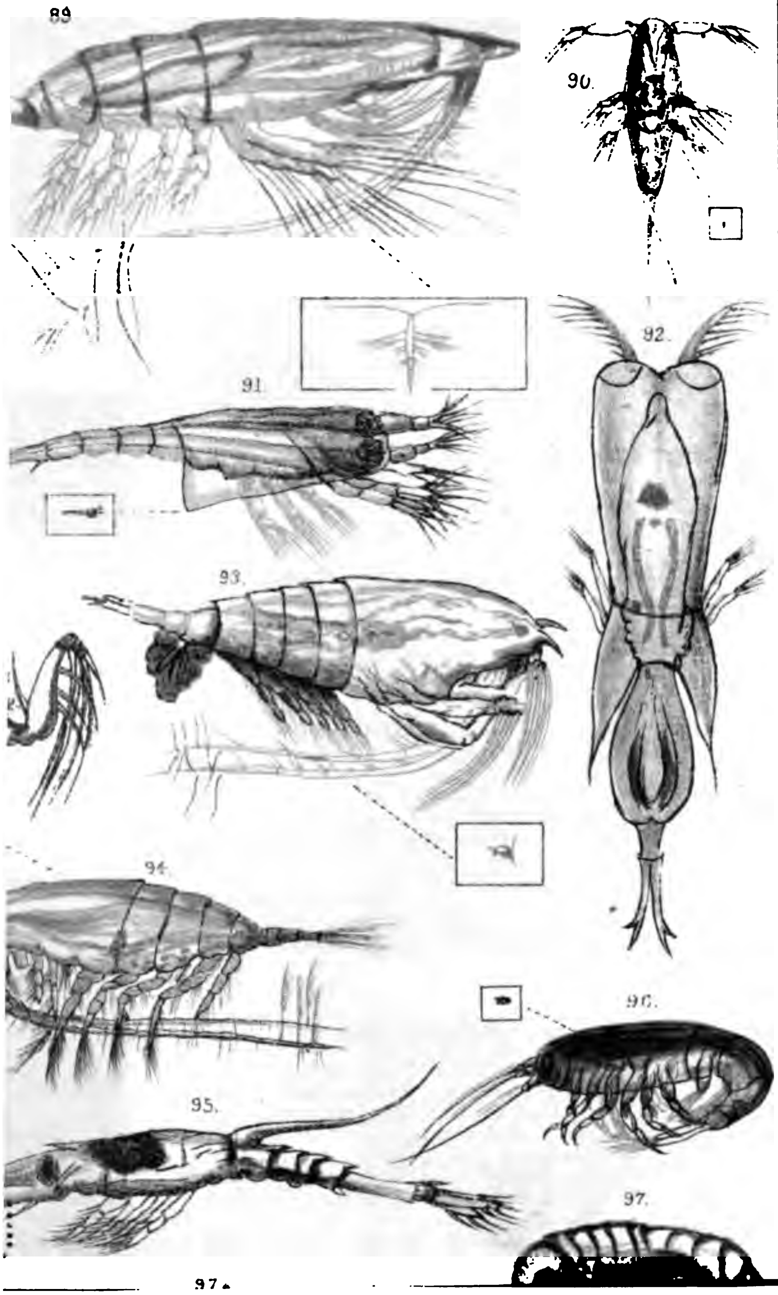
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[DE]LINEATIONS OF SOME MINUTE SEA-SURFACE [A]NIMALS.—From Coloured Drawings by Mrs. TOYNBEE.

PART IV.

(Concluding the Series.)

(*Continued from page* 531.)

[In]structions regarding means of capture, examination, &c., see page 214.

PLATE VII.

Crustacea Stomapoda. Male Lucifer.—
[76] and 77. July 10th, 1858. Lat., 34.58 N.; long., 38.17 W. Current, S. 79° E., 9 miles. Temperature of surface water, 74°.

79 and 79A. Nov. 25th, *Crustacea.* Lat., 10.14 S.; long., 79.58 E. Temperature of surface water, 79°. Pumped up this crustacean, having ova attached to its tail, the hairs at the end of which were like miniature feathers.

Annelid.—May 21st, 1857. Lat., 30.27 N.; long., 45.16 W. Current, N. 41° W., 5 miles. Temperature of surface water, 73.9°. This Annelid was found amongst the Sargassum. Its head was peculiar, but its general appearance and the divisions of its body similar to one previously found on January 7th, 1857.

Pteropod larva?—May 13th, 1858. Lat., 35.03 S.; long., 21.41 E. Current, N. 30° E., 31 miles. Temperature of surface water, 65°. Found many of these Pteropods with actively moving ciliæ.

May 3rd, 1858. Lat., 29.57 S.; long., 38.35 E. Current, S. 76° E., 26½ miles. Temperature of surface water, 72°. Found this creature which seemed to have an outer mantle, the contractions of which were the only signs of life.

Medusa.—Feb. 2nd, 1858. Lat., 15.33 N.; long., 81.20 E. Current, N. 17° W., 4 miles. Temperature of surface water, 78.7°. Found this Medusa, which contracted and expanded its flexible mouth continually, on the edge of which bunches of hairs were distinctly visible.

Annelid.—Feb. 2nd, 1858. Lat., 15.33 N.; long. 81.20 E. Current, N. 17° W., 4 miles. Temperature of surface water, 78.7°. This strange little animal had no apparent motion.

[85] and 86. *Larval Annelid.*—Oct. 23rd, 1857. Lat., 17.57 S.; long, 37.07 W. Current, S. 2° E., 22 miles. Temperature of surface water, 76°. Found this Nereis? which had apparently ciliary motion, both about its head and tail; its long hairs were generally lying along its body when it moved.

[87] and 88. *Annelid Nereis.*—Jan. 7th, 1858? Lat., 14.29 N.; long, 82.32 E. Temperature of surface water, 78°. This creature moved through the water like an eel, wriggling its body rapidly and using its hairy fins as propellers; it became entangled in some Canada balsam and paper on the slip of glass on which it was placed, and, when it disengaged itself, had the singular projection from its mouth shown in Fig. 88.

PLATE VIII.

Fig. 89. April 6th, 1857. Lat., 34.18 S.; long., 25.31 E. Current, S. 49° W., miles. Temperature of surface water, 65°. Towed the net, and caug this crustacean, remarkable for the length of its horn and paddles, or fi with which it kept up a constant motion in the water. No eye w visible, unless the dark spot over the horns was one.

„ 90. *Larva.*—March 9th, 1857. Lat., 7.35 S.; long., 84.11 E. Current, 45° E., 17 miles. Temperature of surface water, 80.4°. This sma transparent crustacean is singular in the shape of its tail, part of whi has, probably, been lost.

„ 91. *Larval Crustacean.*—April 8th, 1857. Lat., 34.53 S.; long., 22.38 Current, S. 77° W., 15 miles. Temperature of surface water, 64°. Tow the net and found great numbers of these larval crustaceans? T three legs were in such rapid motion that it was difficult to make the out distinctly.

„ 92. *New Copepod or a Larva.*—25th Nov., 1856. Lat., 10.14 S.; long., 79. E. Temperature of surface water, 79·9°. This crustacean had ve large and clearly defined eyes.

„ 93 and 93A. *Euchæta Communis* (*diadema?*).—May 9th, 1857. Lat., 3. N.; long., 28.02 W. Current, N. 50° W., 30 miles. Temperature surface water, 79°. Nearly calm; towed the net, and found two spe mens of Euchæta communis (diadema?) having eggs attached to th tails. The turquoise blue of the eggs was in remarkable contrast to t transparent red and white of the body. They differed from others have found in having the eggs placed in one plane, and not in a bunc 93A, one of the fore claws enlarged.

„ 94. *Copepod, probably Pontia or Cyclops.*—Nov. 5th, 1856. Lat., 39.43 S long., 53.29 E. Temperature of surface water, 54.4°. This insect w pumped up from the sea by a pump, the suction-pipe of which w about seven feet under water. It was very active. With a high powe quick vibration was visible along the back, though no ciliæ could distinguished.

„ 95. *Larval Crustacean Macroura.*—March 6th, 1857. Lat., 0.57 S.; lon 82.50 E. Temperature of surface water, 82°. Towed the net an caught this crustacean. The horn projecting backwards is remarkabl the eyes were very prominent.

„ 96. *Young Amphipod.*—March 6th, 1857. Lat., 0.57 S.; long., 82.49 Current, N. 30° E., 25 miles. Temperature of surface water, 81° Th small crustacean jerked through the water by drawing up its ta towards its head; the hind feet were kept in such rapid motion th it was difficult to make out more than that they were hairy, unli the claws of the front part of the body, which were free from hairs.

„ 97 and 97A. *Crustacea, Amphipoda, Phrasina?*—March 27th, 1857. Lat 28.24 S.; long., 48.49 E. Current, N. 56° E., 5 miles. Temperatu of surface water, 73.3°. This creature was caught in the net. It general remained quietly at the bottom of the tumbler, but at times it start up and performed several summersaults in the water. It appeared have a black patch on each side of its head. May 22nd, caught o of the above of a bright lilac colour; it frequently rolled itself up in a round ball. 97A, is an enlarged view of the most prominent of tl fore legs.

Evening Meeting.

Wednesday, May 5th, 1875.

Major-General T. B. COLLINSON, R.E., in the Chair.

ON THE PROPOSED ENCLOSURE OF DOVER BAY.—REVIEW OF DESIGNS AND HISTORICAL ESSAY ON THE HARBOUR.

By John Baldry Redman, F.R.G.S., M.I.C.E., &c.

The interest attached to this subject, and its national importance, are best shown by a short reference to the early advocacy of such a measure. The first complete design being that of the reign of Henry VIII. The smaller area of enclosure, viz., about 150 acres shown in the diagram of the various enclosure designs, and such a measure was advocated by the great Sir Walter Raleigh even in his day. This plan is interesting, as fully recognizing the laws which govern the movement of the southern belt of shingle, as having a determinate leeward movement eastward up channel, shown by the two projecting groynes from the west pier, designed to arrest it, to form a protecting slope and keep open the harbour's mouth.

Dover as a military station attracted attention from the days of Cæsar, whose description assigned to this port, and the numerous works of the Romans, all testify to its importance. Henry VII erected a round tower on the western side of the harbour, with moorings; and during the subsequent reign a new west pier was erected, but the shingle soon blocked up the entrance. This frequently occurred, and the harbour was inaccessible to vessels for years continuously.

Harris, in his history of Dover, records that Henry VIII expended about £80,000 in improving the harbour, and Henry the Eighth's west pier was completed by Elizabeth in 1585, but not to the full length of the foundation laid by Henry VIII, called the "Mole Head," and which was cut through by the present pier in modern times. The great blocks of stone for this early work, of twenty tons each, were brought from Folkestone on frames of timber floated on empty casks, and the chalk stones for filling-in were brought from the north-east side, in a great boat, called "Gaboth," which had nine keels. The king encouraged this work, personally viewing its progress, and giving £50,000 towards it, but at his death it went to decay, and in Queen Mary's reign an attempt was made to carry it on, which failed for want of funds. The beach drove quite through the piles and choked the harbour, making a shelf from thence easterly to the bottom of the cliff called "Castle Ray," the river forming an uncertain outlet assisted by manual labour. These causes, and the loss of Calais about the same period brought Dover into decay, lapsing into the condition of a mere shingle haven, like other small ports along our south-eastern shores. This shelf became subsequently an effectual

barrier; and a stone wall was partly built in Elizabeth's reign from the Water Gate, where the river ran into the sea, to the "Block Bulwark" on Henry the Eighth's Pier, 1,100 yards in length, and if completed would have cost £100,000. The surveyor to this work, John True disgraced his name, and was not faithful, and was succeeded by one Ferdinand Poins from the Low Countries, who had been engaged in repairing breaches in the Thames embankments at Erith and Woolwich, who undertook to make certain "knocks" or groynes, and a wall from the Water Gate to "Castle Ray," about 660 yards in length, on the eastern side of the harbour frontage; and another wall at right angles landward to the cliff, 220 yards in length. Great discussion ensued as to how those walls were to be formed. Poins proposed oaze and beach; local shipwrights, wooden walls; Sir Thomas Scott, "arming," as at Dymchurch wall, Romney Marsh, and men from that locality were eventually employed, under a Treasury Expenditor and Surveyor. The work was begun May, 1583, walls of earth, chalk in the middle, sleech on the outside lined with faggots; in three months the whole "perimeter" or inclosure of the harbour was finished, and had no leaks, and continued so for three years, and then at quarter flood a ship of 50 tons could enter, and at high water 300 tons, and two jetty heads were finished, "perfecting the mouth of the harbour.

Those works amounted to £2,700. Sluices were also then formed; the first small sluice in the cross wall being taken up and superseded by one 80 feet long, 16 feet broad, and 13 feet deep, with two gates, and which took a "whole month in laying." "The good Lord "Cobham staid there all the time, and kept a table to encourage the "workmen."

James I appointed a Commission to supervise those works, and by the charter of this monarch, 1606, the back of the pier or harbour ground was granted to the Warden and Assistants of Dover Harbour.

Much interesting light is thrown upon the condition of Dover Harbour at an early period by the drawings in the Cotton Collection of the British Museum, principally referring to the reigns of Henry VIII and Elizabeth, showing that the harbour was formed by the flow and reflux of the tidal waters through the beach, cast up across the inner side of the bay by the waves from south-west, with three main channels in the direction of the inner pent. Arch Cliff to the west is described as a cliff with bulwark and groyne at foot, and thence to the south pier a castellated wall, with guns backed by a stone slope, and terminated next the pier by a stone bulwark mounting guns, with loose stones thrown at the foot; from this a timber groyne or pier projected in a south-westerly direction, apparently to arrest the beach and from the stone bulwark a south pier, convex outwards, covers the entrance from the south-west, with guns mounted at the head, and loose stones thrown down at the foot; the north pier, of a crescent form, curved outwards, of timber, with a pole and lanthorn at the head, is considerably overlapped by the south pier; a large amount of beach is shown fronting the bay and surrounding the Haven waters. The importance attached to the military defence of these works is shown

by these early documents. During the reign of Elizabeth, the harbour assumed somewhat its modern form, with the inner pent and outer pent and the outer harbour, called by the mariners of that day "Paradise," and there appear to have been two groynes between Archcliff and the "Block Bulwark" of Henry VIII, which stood near Cheeseman's Head, which was incorporated in the root of the present Admiralty Pier.

From the head of Queen Elizabeth's south pier, and in the same line, ran the foundation of Henry the Eighth's, in a straight line easterly for 660 feet, terminating in the "Moule Head."

Various groynes were situate on the north side of the harbour. The last, called the North Groyne, approximated in position with the north end of the great pent or inner harbour, and the distances from Archcliff Fort and Cheeseman's Head to the north end of the Great Pent, measured from those old plans, exactly accord with those taken from modern surveys: and these documents are interesting, showing as they do how parallel were the circumstances of the harbour at that remote period to those now existing, and that points had been rendered permanent by works of art and the general outline preserved to the present day, modifications of form having been brought about by the extension of former and by the addition of modern works.

The plans of Elizabeth also show that the shore was then protected by numerous groynes forming sudden projections and deep recessions. A plan of 1595 shows that the "Block Bulwark" had gone to decay; that a new north pier was contemplated that year; there was then a "*Becon on the Moule Head*," and on it we find the extent of Henry the Eighth's foundations, justifying the praises of old writers; from 200 to 300 feet seaward of any modern works prior to the erection of the Admiralty Pier of the present day.

Leland, Camden, Stow, Burton, Sumner, Stukeley, all describe the town and harbour; and Camden has the following truthful and noteworthy passage:—

"The town lying among the cliffs where the harbour antiently was "(when the sea came up thither, as may be inferred from the anchors "and planks dug up there), &c."

And again:—

"On the side next the sea, now shut out by a gravelly beach, it "was surrounded by walls, of which some part still remains."

Stukeley also contains the following graphic passage:—

"If we consider the antient state of Dover, we must imagine that "the little river ran directly into the sea and left a harbour close to the walls of the town; but in process of time, as the sea threw up that vast beach which lys between the town and it, the river was forced by an oblique passage to creep along the shore under the Southern Cliff and there vent itself where now is the harbour."

In 1652, it appears there was a depth of 22 feet at high-water springs, the piers and jetties were subsequently erected to make permanent what had hitherto been a fluctuating passage through the shingle.

Lyon in his history of Dover, says:—

"There are no records remaining to point out the time, when the "depth of the stream was so much diminished, as not to admit vessels

"into the valley, but it is certain that, as early as Edward the Confessor, the mariners were obliged to seek shelter for their boats on the eastern side of the Bay, and they continued to use that place as a harbour for many years; for when William I fortified the town with a wall and towers, the harbour was at the foot of the hill, near the wine vaults, where the low ground still appears, and was used for many years as a farm yard, a garden, and for other purposes."

Captain Perry, well known by his memorable work to stop Dagenham breach on the Thames, visited Dover in August, 1718, under the auspices of Lord Aylmer, and he referred in his report to the surveys and "endeavours," from the "great Sir Walter Rawleigh," until his view to render the port available to large ships. He recommended low-built groynes along the beach margin on each side of the harbour, down to low water along the frontage of the town and an extension of the West Pier.

Captain Perry's report concludes thus:—

"There is more riches frequently lost in one storm by merchant ships being driven from their anchors in the Downes, than would make this a common place of safety for a very considerable number of such ships. And your Lordship can best judge how great an expense would be saved, and what advantage would accrue in time of war, by making this a port convenient for cruising ships."

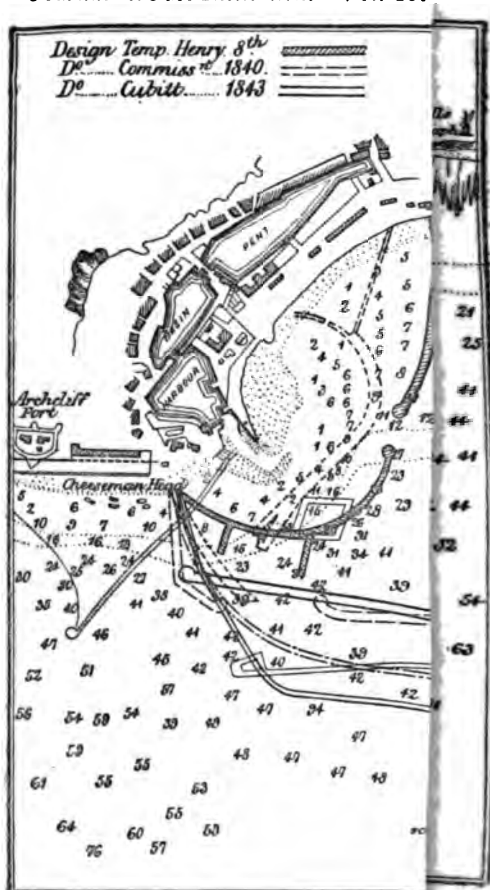
Smeaton reported on the harbour in June, 1769, and referred to the importance attached to it as a national object from a remote period, to the changes it had undergone and the manner in which it had for years been blocked up with shingle, he discouraged groynes, the necessity for which he said would be "*eternal;*" he referred to the danger the Pent wall was in formerly from a breach, until a fall of the Castle Cliff arrested the beach, made more permanent by the subsequent erection of the "Castle Jetty," and consequent accumulation of shingle, also to the erection of "Cheeseman's Head," and to the diminution of its effect in arresting beach, consequent (he said) on its decay.

Smeaton, like Perry, proposed an elongation of the West Pier, and certain improvements in the sluices.

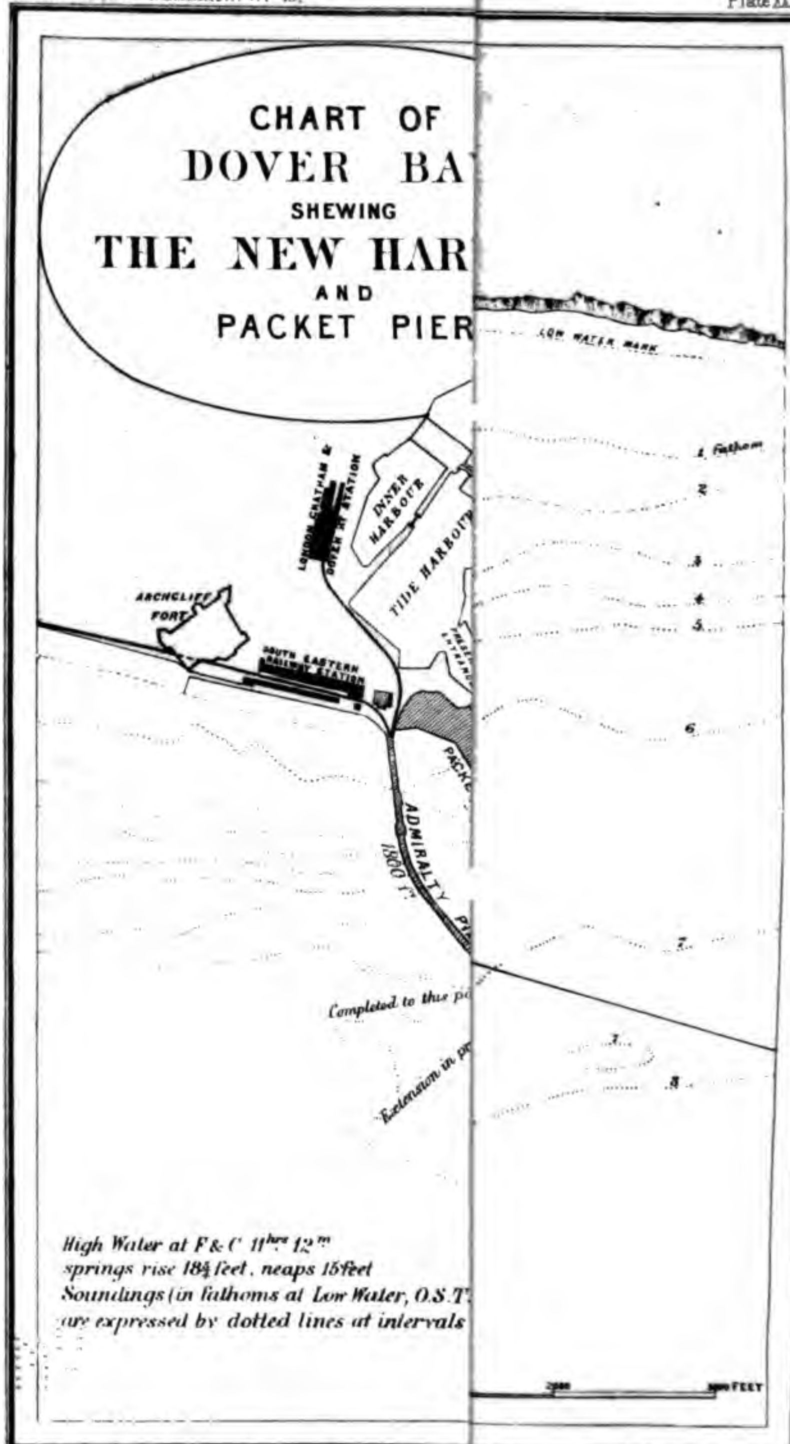
Telford, during the winter 1833—34, was called in by the late Duke of Wellington, then Lord Warden of the Cinque Ports, and Chairman of the Harbour Trust, to report, consequent upon the continued increase of shingle and blocking up of the harbour, who advised and partly carried out the extension of the sluicing power from the Inner Harbour to a reservoir and sluices in the South Pier Head extended and a low water external apron therefrom.

At his death these works were completed, together with extensive improvements of the Pent and Inner Harbour, by the late James Walker, Past President Institution C.E., who also subsequently carried out the Admiralty Pier, now under the charge of Mr. Druce, who for many years was resident engineer.

The report of the Commissioners on Harbours of the south-east coast, describes the then condition of the works, and suggests that their extension and improvement, and an elongation of "Cheeseman's Head," are all "*most desirable.*"



Design Temp. Henry 8th
Do. Commissrs. 1840.
Do. Cubitt 1843
PENT
BASIN
HARBOUR
Archcliff Fort
Cheeseman Head



Stanford's Geog^l Estab^t, London.

A joint report by Colonel Thompson and Captain, afterwards Admiral Beaufort, recommended in any design for enclosing the bay that the East and West Piers should be connected with the shore and *commenced simultaneously*.

The report of the Harbours of Refuge Commission, refers to this "advanced port on the south-east coast," and that it "has attracted "the notice of sovereigns and ministers from the earliest times, and "has led to a large expenditure of money, for the improvement of the "present tidal harbour."

The opinion of Mr. Pitt, who employed the elder Rennie to report, is dwelt on, as also the satisfactory results of Captain Washington's examinations.

Both reports of 1840 and 1844, place Dover first on the catalogue of sites for harbours of refuge.

Before both these Royal Commissions, the highest naval evidence of the day was given advocating the enclosure of the bay; amongst others by Admirals Beaufort and Washington, Captains Bullock and Calver, R.N., and Mr. Iron the Harbour Master. That of the first has before been referred to, and Captain Bullock was of opinion, that taking all circumstances of position, present works, &c., into consideration, Dover was the most advantageous site for an artificial harbour of refuge, for the protection of the narrow seas, and that a harbour of refuge could not be made in the Small Downs, under any circumstances, equal to Dover, and that when coupled with defence, the latter site was preferable to any. Captain Calver gave similar evidence, his fear of deposit *then* arose from deposit from the *fresh inland waters*, and he considered the communication between the Inner and Outer Harbours should be cut off, and he did not apprehend much deposit from the still water, however, it would share, he supposed in a degree with Ramsgate this objection, but there would be less deposit, due to the greater depth and consequent distance it had to fall.

A diagram (Plate XXVIII[1]) is given of the main designs that have appeared on this subject, viz., that of Henry VIII; the Government in 1840; that by Sir William Cubitt, 1843; by Sewtard, 1843; the Government design, 1844; and last, that by Captain Vetch, a Royal Engineer Officer at that time (1844) employed by the Admiralty.

It will be observed that the eastern termination of the Government designs of 1840 and 1844, do not extend one-half the distance from the Castle Jetty to the Cornhill Telegraph, west of the South Foreland, it has, however, been industriously stated of late that the great Harbour of Refuge project extended to the latter point to throw discredit upon it, involving as it would then appear, the enclosure of double the area of water ever contemplated by any Government, and Captain Calver, R.N., in a recent pamphlet in defence of certain changes of opinion, or modifications of view, has not hesitated to state that the Cornhill Telegraph was the point selected for the

[1] The originals of Plates XXVIII and XXIX are from "Engineering," and of Plate XXX from Captain Hoseason's pamphlet, "The New Harbour at Dover, &c." Plate XXIX represents Captain Sir Andrew Clarke's original design, Plate XXX his design, as modified and deposited in Parliament.

eastern termination of enclosure, *i.e.*, as before stated, double the distance eastward from the Castle Jetty to that really chosen.

The recent modification of the area proposed by Sir Andrew Clarke R.E., is shown upon the Admiralty Survey, with the modified and *extended lines* (as compared with 1840) of the Government of 1844.

When the results at Holyhead, consequent on commencing with a defined area of enclosure, subsequently extended, are considered, it is hardly necessary to urge the importance of a very mature consideration being given to the selection of the site for the commencement of the East Pier.

By adopting a point just east of the "Castle Jetty," and reducing the distance to the outer lateral breakwater, the area is reduced one-half; but the length of breakwater is by no means diminished in the same proportion, as the absolute saving in length is one-fourth, and that at the sacrifice of 100 acres of deep water of 38 to 40 feet available to ironclads, enclosed within the south-east angle of the design of 1844. The most sheltered portion, and away from and not interfering with the continental traffic, the more important when the probable altered conditions consequent upon the introduction of larger vessels are considered, and also distant from the stream of traffic to the commercial harbour.

The question of area appears to be illustrated by the Holyhead example, for Dover, as a great military station and anchorage near the Downs in time of war, commanding the navigation of the Channel, would appear to demand an increase rather than a diminution of the area of enclosure when the increase in the size of shipping is considered; and this without any reference to the condition of the Navy up to the present time, tentative and unsolved, and would appear to warrant the conclusion that Dover, as a naval station should afford as nearly as the site will admit, the same facilities as Portland, Cherbourg, or Holyhead. It is also worthy of notice that the two areas of enclosures endorsed by Her Majesty's Commissioners of 1840–44, are almost identical, with this difference, marked and significant enough, that the design of 1844 enclosed a *larger* area and projected from a furlong to a quarter of a mile further seaward, leading to the inference that Her Majesty's Commissioners were of opinion that an extended and not a reduced area of enclosure was demanded by modern requirements, added to which the finished head of the Admiralty Pier coincides with the south-west angular bend of the design of 1844, *i.e.*, 1,000 feet in advance, or seaward, of the same point of the design of 1840, another telling and significant fact.

The evidence before the Commissioners of 1840—1844 led to the same conclusion, that Dover was first in importance as compared with all other stations, military or naval.

The great length of time (thirty years) during which the Admiralty Pier, or Western Breakwater of the Enclosure, has slowly advanced towards completion, and the revolution effected in the Navy in that period have tended to the result that Dover is more thought of as a place of embarkation and disembarkation for the continental traffic

than (if the Bay were enclosed) a most important adjunct of national defence, and the very key of our position, east and west.

All the works of military defence executed by Her Majesty's Government during the above period, conceived and carried out in a spirit emulating that which actuated Henry VIII, Elizabeth, Burleigh, and Raleigh, have been apparently planned to convert the site into a British Gibraltar, and would appear to lead to the conclusion that the base of the enclosed sea should approximate with that of the shore defences recently executed for the protection of the sea front, flanks and rear of the town.

An impression prevails that the Government design of 1844 extended to the South Foreland as before stated, and that would be two miles eastward of the town, whereas the whole area of enclosure, including the one mile frontage of the town, is only one and a half mile across the Bay.

The chief arguments that have been used in favour of a reduction of the area were its proximity to the Downs, and that harbours of refuge are not now required as they were thirty years back, due to the extension of steam and gradual extinction of sailing shipping.

As regards the first, the opinion of Captain Perry, an old merchant captain, and the naval commanders before quoted, may be referred to, as also the statistics of the Annual Wreck Register Chart, to show that the frequent casualties on the "treacherous" Goodwin Sands, to a great extent would modify this view.

As regards the supposition that sailing must be gradually superseded by steam shipping, though to a degree true, it is also in a degree hypothetical, as will be seen by a study of the Board of Trade returns of our trade, and navigation and shipping statistics, illustrating as they do the continued marvellous progressive increase of the commerce of this realm.

On this point the following curious calculation may be referred to which appeared in the *Pall Mall Gazette* of 3rd December, 1874, taken from the *Bureau Veritas*, and which no doubt may be relied on as tolerably faithfully depicting our commercial position as a maritime power.

"*Mercantile Navies of the World.*"

	Tons.
No. 56,289 sailing vessels	.. 14,523,630
,, 5,365 steamers	.. 5,034,337

So that sailing vessels are yet ten times more numerous, and carry nearly three times the commercial tonnage. And to show our preeminent commercial status, one-third of the above amount of sailing vessels are British, viz., 36 per cent. of the vessels and 37 per cent. of the tonnage. As regards steamers, more than one half are British, viz., 58 per cent. of the vessels and 60 per cent. of their tonnage.

The present unfinished state of the design leads to the result that there is a considerable local shoaling under the pier and deepening elsewhere—what has in effect been termed a redistribution of material,

the average depth over the bay remaining unchanged, and would no doubt cease on the completion of the enclosure, or would rather take place to leeward of it, and beyond its area.

This result has been well described in a joint report to the Admiralty of 17th May, 1865, by Admiral Bethune and Captains Calver and Bedford, R.N. There is one important paragraph in this report that may be quoted, viz.:

"We may mention incidentally that the Admiralty pier has proved "highly beneficial to Dover harbour, both by preventing the accumu- "lation of shingle at the entrance, and by materially reducing the "silting up within, so that the harbour can now be taken at almost "any time when the depth of water will permit."

Without raising the question as to whether the Admiralty pier is the cause of the present absence of shingle eastward, as there are more active agents at work to the windward or westward of it, no stronger argument than the above quotation could be used for the immediate completion of the original great design of 1844.

Several objections may be enumerated against a retrenchment of the design of 1844, adopted by the Government after so much deliberation, viz.:

The loss of deep water south-eastward.

The curtailment of design limiting the frontage of the town to the Castle Jetty.

Thus fixing a limit to improvements eastward and reducing the length of sea promenade available to the town in the designs, 1840-44.

The loss of area north-eastward for the establishment of graving docks, ship yards, and other appliances for naval purposes, or for coaling on a large scale.

Also retrenching and rendering more difficult the communication by military roads with the Heights and Castle.

The enormous future expense that would be entailed if an outer harbour were found (as some of the advocates of the retrenched area have admitted might be) necessary.

More direct interference with the inner and commercial harbour, and also with the continental steam traffic, than in the design of 1844.

These sacrifices of area, frontage, the sea promenade in the bay being one of the chief attractions of the town, and the contingent opportunities of great local improvements the modification of the plan brings about, restricting the frontage to the old time worn boundaries, attempts to extend which have hitherto been checked by the ravages of the sea on the unprotected shore eastward of the Castle Jetty, where, however, there was a few years back a broad belt of shingle extending to Saint Margaret's Bay.

This retrenchment of the eastern boundary of the design by three furlongs, bringing it to a point just east of the Castle Jetty, producing the above results, involves a saving of 25 per cent. in the length of breakwater, but reducing the area in double the proportion, viz., from 600 acres to 300 acres, and that at a period when increased and still increasing tonnage for war or commerce is the order of the day, together with the improved means of defence by artillery of in-

creased and increasing range, and this applicable to an enlarged rather than reduced area.

It should not be forgotten that what is now termed the Government design is a modification proposed by a military engineer, Colonel Sir Andrew Clarke, R.E., and that it was only carried at the fag end of the Session before last, in a thin house, at a late hour, by a majority of one; and that the scheme was characterized by the Treasury as late as 20th June, 1873, as "not altogether mature;" and the present Government, on taking office last Session declined entertaining the question for want of sufficient information.

Admiral Washington, the late well known and respected hydrographer, absolutely recommended an enlargement of the design of 1844; the great Duke of Wellington was a firm supporter of the original project, and the military and naval authorities thirty years back were quite alive to the question of defence of the frontage, which must now be still more readily protected from the land side.

It is difficult to understand, as some have asserted, that the piers of 1844 would be less available in peace and war for embarkation and disembarkation; taking this view, it would be better to go back to the lines of Henry the Eighth's time, and have only an enclosed area of 150 acres.

To view the enclosure of the bay purely from a military point of view is surely a mistake, and a harbour of refuge in 1844 was intended as much for the navy as the mercantile marine; and to ignore the existence of the inner harbour is not politic, added to which the objection to sailing vessels in a naval station must have had the same force in 1844 as in 1873.

For the purpose of comparison, it may be stated that at Holyhead the original area proposed to be enclosed by the first bend or cant of the breakwater was 400 acres. This area was increased by extension and altering the direction, producing the ugly result before referred to, by an addition of 260 acres, making a total of 660 acres.

At Portland and at Cherbourg in each case the area of enclosure is 1,000 acres, and at Plymouth 700 acres.

As regards entrances, some of the designs contemplated a severance from the shore, this idea is now, however, by universal consent, in the best informed quarters, altogether abandoned.

In the first design of 1840, there were three entrances, respectively south-west, south, and south-east. In the design of 1844, a main south entrance and a smaller eastern entrance which although adopted at first in the present modified plan, is now abandoned, as it would promote deposit in the harbour at a rapid rate from the still water to leeward, when the enclosure is completed.

As regards position, the entrance of 1844, and that of Sir Wm. Cubitt, of 1845, are the best of all, for obvious reasons.

As regards width of entrance, all the best evidence of 1840–1845, show again that extension and not retrenchment, is necessary, and that an entrance of nearly 1,000 feet is necessary, and that no altered conditions of recent years affect this conclusion.

The question of entrances is one that will demand great considera-

tion, as in all probability a second entrance will be found necessary at the south-east angle, a site proposed by persons well acquainted with the port. Most undoubledly the entrance shown in the amended design towards the south-west angles of only 600 feet, and not situate at the most salient angle of the enclosure will be found ill-placed and quite inadequate.

The late Sir Wm. Cubitt, C.E., Past President Institution C.E., in his amended design of 23rd August, 1845, which is perhaps, as regards approach, the best studied plan extant for the enclosure of the bay, proposed including 750 acres with a south-east entrance 450 feet in width, and 37 feet in depth at low water, and a southern projecting entrance of double the capacity, or 900 feet in width, and 42 feet depth of water at low water.

The following extract from an opinion on this plan under instructions from the Board of Ordnance and Admiralty by Lieutenant-Colonel Thomson, R.E., and by Rear-Admiral Beaufort, R.N., Hydrographer to the Admiralty, on the 9th December, 1841, respecting the entrances requires no comment.

"We would strongly recommend that both a western and an eastern "pier be carried out simultaneously from the shore." . . . "to "enclose a basin of equal dimensions to that in Mr. Cubitt's plan, "but leaving an opening through the pier heads of 800 or 900 feet, "through which any ships can beat in and out with undoubted "facility."

Rear-Admiral Sir James Gordon, one of the Commissioners of 1840, and a witness before the Commission of 1844, held similar views.

Captain Bullock, R.N., another witness, considered two entrances sufficient, but preferred a greater width than 700 feet.

Captain Iron, for so many years the well-known harbour-master, advocated a width of 1,000 feet, for the main southern entrance.

Captain Calver, R.N., another witness, held that this entrance should be 900 feet wide.

The question of reduction of width of entrance, like that of enclosed areas, is mainly dependent on the assumed altered conditions of shipping, and this consideration the statistics before given of sailing and steam shipping will enable a judgment to be formed on.

Whether the enclosed area be of 600 acres, or of reduced dimensions, it is to be assumed that it will be a free port during peace, and a place of safety for ships, royal or mercantile, sailing or steaming, but its usefulness dependent entirely on accessibility and the character of its approaches.

It may be well here to state the capacity of the entrances of our great national harbours.

Plymouth has two entrances: 1,200 feet east, 2,000 feet west = 3,200 feet. Portland is an open roadstead to the north-east, round the end of the breakwater; the depth of the bay = 9,000 feet, with a small west entrance of 400 feet. Holyhead is similarly a semi-open roadstead, and has an offing or entrance round the north-east of the breakwater, 5,000 feet, and between the breakwater and rocks of the

inner anchorage = 1,000 feet. Cherbourg, like Plymouth, has two entrances, 1,400 feet east, 2,600 feet west = 4,000 feet.

The conditions affecting the entrance to a harbour are mainly these, extent of offing and winds acting thereon, average depth of surrounding ocean channel, depth of entrance at low water and rise of tide, the combination of these circumstances affecting the character of entrance required, and this is a very variable quantity.

The question assumes more importance in the case of Dover Bay, as if enclosed it will be the largest artificial national harbour of its class extant, as all the examples quoted above are either isolated breakwaters, or connected at one end only with the shore. A parallel may be found to an extent in Kingstown Harbour, Ireland, which is very accessible, and has remained tolerably free from deposit, but which, enclosing only 250 acres, has an entrance 750 feet wide. This example again illustrates the question of area, if 250 acres be required at Kingstown, in Ireland, what should be the area at Dover?

A second south-east entrance would be of immense importance on a sudden change of wind from east to west, to vessels wishing to get away up channel. The west entrance at Portland serving the same purpose on a change of wind in the contrary direction enabling small vessels to get away down channel without making the circuit of the breakwater.

By the Bill now before Parliament some modifications from the first reduced plan have been adopted, as shown by the deposited plan.

The east pier is proposed to commence 450 feet east of the Castle Jetty, and to extend 1,900 feet in a southerly direction.

South of this east pier an eastern opening no less than 800 feet in width is now proposed.

Southward of it, the eastern arm (in a south direction) of the South Breakwater is to extend 1,200 feet to the south-eastern angle of the enclosure, and thence in a south-west direction, 2,100 feet to opposite the end of the Admiralty Pier, to be extended 550 feet eastward, leaving an opening of 600 feet, by which the enclosure is completed southward.

No less than three designs have appeared for this retrenched area of enclosure, and all emanating from the same quarter.

In one case with a single south-west entrance of 550 feet.

In another a similar south-west entrance and an eastern one of 300 feet only.

Whilst in the last design we have a south-west entrance as before, with 800 feet of eastern entrance, and that at a point where all the other enquiries placed the smaller entrance.

This fact that the entrance space is already doubled by the authors of the modern design consequent on two years' deliberation would apparently tempt one to draw the conclusion that a continuation of their studies might produce a similar happy result as regards the enclosure area.

It must be remembered that our national harbours at Holyhead, Portland, &c., are the outcome of the harbours of refuge and similar enquiries, and that although there has been considerable change of

opinion as to the necessity of providing asylum harbours for commercial vessels, that the site at Dover was ranked as first, either for national or mercantile considerations as regarded the traffic of the narrow seas.

It must be patent that the Downs offered the same facilities in 1840—1844, duly considered by the Commissioners of those years, as at the present day.

The proportion of Baltic and North Sea foreign imports and exports is precisely 35½ per cent. of the whole foreign tonnage of the port of London, two-thirds of which nearly thus pass through the Straits of Dover, and during the last quarter of a century from 1850 (when the yearly aggregate foreign tonnage was under 4,000,000 tons) this trade has more than doubled itself, and the average tonnage of ships carrying this enormous commerce has increased from 200 tons per ship to 400 tons. The yearly tonnage now exceeds 8,000,000 tons.

To what inference, as to area of enclosure at Dover, do these statistics lead?

A comparison of the Admiralty Charts of 1859, 1873, shows the following general results, the whole of the shore to the westward of the Admiralty Pier has grown out. The amount of deposit, averaging vertically about 2½ yards, but in places where heaped up against the pier, amounting to from 12 to 16 feet.

The total amount of deposit on this side, as far as the charts extend, is over one million cubic yards, this quantity may, however, be indefinitely enlarged, as the action no doubt extends westward to Folkestone.

As regards the shoaling east of the pier, one-half is due to the silting up of the head of the deep water from the westward, formerly extending east of the pier, and which existed in 1859, filling it up to the normal depth in the bay north and east of it, with as much additional deposit above.

In fact, if the deep water patch, in the chart of 1859, be compared with the area of deposit of 1873, it will be seen that the outline of the deposit spit, is almost identical with what was the termination of tidal and wave influences in former years. (Plate III.)

The whole quantity is about 400,000 cubic yards, and would possibly, at a shilling per cube yard, represent from £1,400 to £1,500 per annum for dredging.

The amount of shoaling at the various landing jetties is as follows, at the north-west jetty there is apparently about the same amount of water, at the main west jetty there is 7 feet loss of water, at the inner north-east jetty there is no loss of water, at the outer north-east jetty there is likewise no loss, but at the main eastern jetty, which is situate at the centre of the spit or shoal of deposit, there is a loss of no less than 17 feet.

This is a matter which will no doubt receive careful consideration from the Committee of the House of Commons now sitting.

The bay generally is as deep and even deeper in places than in 1859.

If the number of wrecks be taken as an argument in favour of

harbours of refuge, it is a more cogent one now than in 1844, in a two-fold degree.

It appears from the wreck chart, compiled from the Admiralty and Board of Trade returns, that in the five years, 1852—1856 inclusive, the number of vessels wrecked on the coasts and in the seas of the United Kingdom, was 5,128, or an average annual loss of 1,025 vessels, and the loss of life, as far as can be ascertained, 4,148, or an average annual loss of 829 lives.

From the same sources of information, it would appear that in 1871 the number of wrecks was 1,927, and the number of lives lost 627. In 1872, number 2,381 wrecks, and number 590 lives.

So that the average number of wrecks is double, but the loss of life (due no doubt to the Life-boat Association and improved means of communicating with wrecks from the shore) has been reduced about 25 per cent.

Lamentable as this increase of wrecks is, due to the more crowded condition of our seas and the more constant passage of steamers, it must not be overlooked that the Board of Trade returns show conclusively, that the export and import tonnage of the United Kingdom during the above twenty years has more than doubled itself; the total tonnage with cargoes and in ballast being, in 1852, just over sixteen millions of tons, and in 1871 much over thirty-six millions of tons, fully accounting for the increased number of wrecks.

The saving of life, due to the meritorious efforts of the Life-boat Association, bears therefore a much higher rate of decrease than as above stated.

The real proportion per vessel would stand thus :—

		Proportion of man per vessel.
1852—1856......	$\frac{829}{1025}$	= ·80
1871............	$\frac{626}{1927}$	= ·33
1872............	$\frac{590}{2381}$	= ·25
1873, six months	$\frac{728}{1206}$	= ·60

Number 1206 vessels.
728 lives.[1]

The practical result is, therefore, that 50 per cent. more lives now are saved proportionate to the tonnage traffic, than were saved twenty years back.

To show the importance of starting sufficiently eastward with the eastern breakwater, so as to be able to enclose as large an area as

[1] Number 293 in one crew, the "Northfleet."

modern enquiries, experience, and demands may require. referen has been made to the cases of Holyhead and Alderney, in both whic cases, from the breakwaters having been extended in length an further out seaward, than at first contemplated, a valuable area anchorage has been lost in each case, that might have been additio ally enclosed, had the ultimate terminal head of the breakwater i each case been designed from the first, when these works wei started.

The areas thus lost are at Holyhead 70 acres, which would ha added just over 10 per cent. to the present area of 660 acres no enclosed, and with a better line and shorter length for the breakwate at Alderney similarly the area lost amounts to 40 acres, or 33 per cen of the area of 120 acres, now enclosed with a shorter length for th breakwater, now curved in the wrong direction on plan.

In each case these lost areas would be higher, supposing the pie had been planned so as to form a segmental arc seaward.

The national character of this undertaking, its importance in th event of war, together with the great commercial interest of th question, appeared to the author to warrant a recapitulation of wh has taken place up to the present time, to bring about this desire result, and that before no more fitting tribunal than the Royal Unite Service Institution, could such a subject be brought, as the propose enclosure of Dover Bay.

Questions have been asked as to the object of this paper. They a mainly to direct attention to what is under cover of a hybrid, ha private, half Governmental Bill, before the Legislature, an attem to obtain powers for one of the greatest works of modern times, r specting which, amongst those really possessing information on t subject, considerable disparity of opinion exists.

His Royal Highness the Duke of Cambridge, Commander in Chie whilst under examination before the Committee on Thursday last, w asked by the Chairman,

> "Your Royal Highness considers this proposal one of the mo "important that ever came before Parliament?"

He replied

> "Certainly."

His Royal Highness was further asked by the Chairman,

> "Is the area of the proposed Dover Harbour sufficient f "military purposes?"

His Royal Highness replies,

> "It is sufficient, but if a greater area could be given so much th "better. *We want plenty of room*, and I should accept th "Dover Harbour as the best I could get, ***but not as all the spac*** "*we want*."

His Royal Highness's evidence most entirely endorses the author'

chief proposition, viz., that the deposited plan now before Parliament, as regards area, is inadequate, and that the Royal Commissioners' design of 1844 requires expansion rather than reduction.

It must also be borne in mind that His Royal Highness was speaking as a military witness, and was not asked a question respecting the commercial harbour or the increased space required for colossal Bessemer, Dicey, or other steam ferry boats.

The second object in this paper has been to direct attention to the altered condition of the bay, due to lapse of time, unknown to a large number otherwise interested in the subject, and the extent of which is denied by many who do know and can appreciate the gravity of the circumstances, viz., the enormous amount of silting which has taken place to windward and leeward of the Admiralty Pier, and for which, in its full extent, the author was certainly not prepared, although he has for more than thirty years back devoted special attention to this particular subject, and has been largely employed by Her Majesty's War Department in reporting on coast changes as affecting Government works in the Medway, at Deal, Sandown, Dover, Eastbourne, &c.

These two considerations, the inadequate area, coupled with the vital importance of selecting a point sufficiently eastward for the east pier of enclosure, to avoid such mistakes as those at Holyhead and Alderney, and the very grave question of the silting up, and its possible future conditions when the bay is wholly enclosed, are, it is submitted, two sufficient apologies for this voluntary and unasked-for contribution to the subject from one who, from professional connections, has made the subject one of years' consideration.

As regards the objection to harbours of refuge, it is one of name more than aught else.

The Royal Commission of 1840 was appointed to report on the harbours of the south-east coast, and gave no definition to them.

The Royal Commissioners of 1844 show that their views as regarded Dover were as much strategic as aught else, as they reported in the following terms, viz. :—

> "History affords proof of the importance attached to this place "*as a military and naval station.* As the advanced post on "the south-east coast, the want of a harbour here *of sufficient* "*capacity for the reception of vessels of war*, and for the con-"venience and protection of trade, has attracted the notice of "Sovereigns and Ministers from the earliest times."

The plan of 1844 was to meet those requirements thirty years back. The question arises, does a doubled commerce, leviathan ferry-boats, an ironclad navy, and increased inner harbour traffic, cry for a reduced area.

As regards silting, the foreshore accumulation westward is not likely to prove serious for the enclosure, and as regards the deposit east of the Admiralty Pier, this, in a modified amount, may be expected mostly to leeward, or east of the enclosure.

These results are drawn from two Government documents—the Admiralty Charts of 1859 and 1873; but they are accompanied by a deepening on the inner side, due to the counter flood current caused by the pier.

The CHAIRMAN: The object of our discussions in this Institution is to call out the expressions of opinion of the members of the two professions upon the importance of any measures relating to the defence of the kingdom, and also upon the merits of the details of the plans for such measures. We have already had here some discussion about the general importance of Dover as a military harbour; and, to-night, Mr. Redman has more particularly brought before us some questions relating to detail, and particularly to alterations that have taken place in the harbour, and affect the question considerably. I hope, therefore, we shall have some opinions expressed upon these points.

Captain BURSTAL, R.N.: It has given me great pleasure to hear Mr. Redman's paper read by him. It is unquestionably a subject of very serious consideration to everybody concerned, whether there should be an artificial harbour at Dover or not. I am not at all sure that the feeling of the nation generally is in favour of a large harbour, such as is projected at Dover. That facilities should be given to Dover for the approach and departure of steam-vessels communicating with the Continent, there can be no question whatever. In a military point of view, I dare say, although I am not competent to pass an opinion upon that, from the evidence given by H.R.H. the Duke of Cambridge the other day, it appears that Dover is so locally situated as to make it a most eligible and desirable point of departure in case it should be necessary at any time to embark an Army. Now, affording facilities for naval purposes is another question, and to my mind not only as a sailor, but having been on that coast a great deal, having been the chief assistant on the survey of all that coast, having prepared all the manuscript Admiralty charts of it, and knowing the locality not only of Dover, but of the Downs, of Margate roads, and of one of our principal naval stations, Sheerness, it becomes a question really whether with ships such as we have now, which will ride out any gale in the Downs; and certainly if the wind blows so hard through the Downs from the S.S.E. or S.E., as to oblige those ships to up-anchor and take shelter in Margate roads, it seems very clear that no enemy could keep the sea; therefore, looking at the thing in a nautical point of view, an Officer in command of a fleet would necessarily say to himself, "Where is the best place for me to be? Is it the Downs, where I can run round into the Margate roads and get supplies of coal, or whether it should be, locked up in Dover Harbour subject to be shelled by any one of the enemy's gunboats that thought proper to take a position three miles off where it never could be hit by guns from the shore; for a gunboat stationed two or three miles off can always know exactly her position by means of angles, and regulate her fire so as to shell anybody out who happened to be locked up in that harbour. The desirability of putting a harbour there is, perhaps, not the question under discussion; but still I do think it is one of those points that is interesting to all those who have got the subject under discussion, although it may not be a point under discussion in the House of Commons, for it almost appears, as a matter of course, that they are going to make a harbour there. I think, if they are going to have a harbour there, if it is desirable in the minds of those who know a great deal better on these subjects than I can pretend to, that the eastern jetty should be brought as far to the eastward as possible, and, by so doing, a very much larger space of deep water will be obtained for large ironclad ships to ride in and to take in coals or whatever they may require, leaving the western portion of the harbour for smaller ships. Although I have not for many years examined the depths in Dover Bay between the town and Cornhill Telegraph, yet I have them in my head, and I feel quite sure if the eastern jetty is projected somewhere by the Cornhill Telegraph, they will not have to go very far out before they get to deep water; whereas if the eastern jetty is brought out, probably from the Castle Jetty, they will then have to bring the eastern jetty a considerable distance out before they get beyond a depth of five fathoms at low water.

Mr. REDMAN: The distance is some fifty per cent. greater.

Captain BURSTAL: If the eastern jetty is brought out somewhere to the eastward you will get out to deep water very much sooner, and make a better harbour with very little more expense, and get a very much larger acreage. Those are subjects, as the harbour is to be put there, that are very well worthy of consideration.

The CHAIRMAN: We have here to-night a gentleman who is as well acquainted with Dover Harbour, in its present condition, as anybody in the world, and that is Mr. Druce, the engineer, who has been in charge of the construction of Dover Pier for a great many years. I hope he will favour us with some information respecting the present condition of the harbour and his views with respect to the construction of the project now under consideration.

Mr. E. R. U. DRUCE, C.E.: I have some little difficulty in going minutely into many of the details of the project now before the Institution, from the peculiar position in which the subject stands. It is at the present time, as you are aware, before a Committee of the House of Commons; and, as opinions will have to be expressed, and the subject fully discussed, it is rather premature on my part to say much about it. I should like, however, to refer to one or two points which Mr. Redman has brought forward in his paper. In the first place, he notices as a prominent point (and a very important one it is too) the proposition of the Commission on Harbours of Refuge, and of a harbour in Dover Bay of 1844. I think Mr. Redman somewhat misunderstood the proposals made by that Commission. He referred to an eastern entrance. Now I think they distinctly said they would have no eastern entrance at all. They said they would have a harbour with a minimum area of 520 acres; and their report further shows that they contemplated two entrances of 700 feet each in width, and no others at all. The original Commission of 1844 reported, in the first instance, in general terms in favour of a harbour at Dover, besides mentioning some other places where they considered harbours were required. After that, the Government called for reports from different engineers, six or eight in number. Those engineers sent in their reports with plans; and the Commissioners, or part of them, met a second time to consider those reports. The result of their deliberation was that they somewhat varied their original report, and recommended that there should be no entrance in the eastern arm at all, but *two* in the southern face or breakwater. I believe that is the condition in which the matter stands as far as their report goes. With reference to the present scheme, the position of entrances and the width of them, must be left undecided until the area of the harbour is definitely settled. The limits of deviation proposed in the present Bill are very large indeed, and it would be very premature to settle the width and size of these entrances, which seriously affect the velocity and current of the tide going into them and filling the harbour, until the area itself is settled. I think, therefore, that the position and size of the entrances must be considered as an open question at the present time. With reference to the silting on the west side of the pier there is an important feature omitted. The whole of the sewage of the town now goes out just to the westward of the present Government or Admiralty Pier; and that, I think, will account for a very large amount of the deposit that takes place on the west side of it. I do not think it ought to be called silt on the east side, the term is not an appropriate one. The accumulation arises from a totally different cause. It is merely a re-distribution of the bottom caused by the running out of the Government Pier which is to form the western arm of the new harbour, and not doing as everybody would have liked to have done, viz., running out the eastern arm concurrently with it. There was possibly an uncertainty in the minds of those who were in authority at the time as to what the size of the harbour should be, but whether that or financial reasons was the cause, the commencement of the eastern arm was postponed, and currents and eddies were formed which have done more harm than good to the bottom of the Dover Bay. The report or survey of the Committee of 1865, which is in print, shows distinctly that that re-distribution can be traced to a cause which is quite intelligible. The subsequent survey of 1873 leads also to the same conclusion, namely, that the eddy of the tide running along the shore of the bay has disturbed the bottom, and is so doing a great deal of mischief. That, I think, I pointed out at least twenty years ago as an inevitable consequence. I was told it was premature to consider the question then. It has, therefore, remained for the authorities of the

present day to take up the whole subject afresh, and give it such consideration a take such steps as they may deem to be most advisable; and, as all existing co tracts are being rapidly finished, it will be necessary to consider whether it shall finally closed or something further carried out.

The CHAIRMAN: Can you tell us definitely that the amount of filling up, mark on Mr. Redman's chart, is possibly a re-distribution with regard to amount, a whether it can be accounted for?

Mr. DRUCE: The survey of Captain Calver and his Committee, in 1865, stat distinctly that the mean depths of Dover Bay as compared with those obtained fro the surveys of 1848 and 1859 were practically identical. I have also taken out t quantities of the new survey made by Captain Parsons in 1873, and the same resu is unmistakeably shown. The shingle, I may add, on the west side of the pier is course another thing; that has simply disappeared owing to the prolongation, se wards, of Dungeness.

Mr. SCOTT RUSSELL, F.R.S.: I will take the liberty of saying that I always fe considerable interest in Dover Harbour, as an international communication; but have also felt a deep interest in it, as I might almost say, a naval and military statio because I had the fortune to be a professional member on what we called the Con mittee on National Defence, for some time, and it became my duty to investiga many questions of that kind, and I only feel embarrassed now in making a remarks upon this subject, because I think it is so important a strategical an national question that, first, I do not like to discuss it even in so choice an assembl as this, and, secondly, I think I should like to leave an energetic Government, the present is one, with their hands quite free and unembarrassed to act ve energetically. I was delighted to hear from Mr. Druce, that the latitude reserve by the proposed Bill is extremely great. I should approve of the design now pr posed just in proportion as the latitude to deviate from it was extremely great. Th diminution of the harbour in area, which I hope we have no reason to apprehen notwithstanding these plans, is a great and unmitigated evil. If anybody appr hends anything in the shape of silting in a large area, you have the means of pr venting the silting; if anybody is apprehensive of any inconvenience from hea seas with wide entrances, the cure for inconvenience from heavy seas necessarily what? Size; there is no other cure. Therefore it becomes a good and effectu harbour in proportion as you give it great area; and convenience and safety i entering and going out, requires a certain width of entrance, and that renders lar area indispensable. Therefore, I think we are in positions in which we can on trust that the Government, whatever its present estimates may be, may one da have very largely increased estimates and very largely increased works before the are completed. Let us give them credit for that. There is another point I woul just venture to say a word upon, because I think we might get some explanati from Mr. Redman or Mr. Druce in regard to it. I have a good deal studied th action of the waves on the entrance of harbours at Kingstown, at Holyhead, Portland, and in some of the harbours of France, and I must say that a good de of the comfort, convenience and stillness of the harbour is owing to the choice an arrangement of the entrances. Now, I did not quite catch whose plan that uppe most central one is, but it strikes me as remarkably good.

Mr. REDMAN: That is the plan by the late Sir William Cubitt, that I di tinguished in my paper in the most favourable terms.

Mr. SCOTT RUSSELL: Permit me to say, when I look at the position of th entrances of that particular design, and when I look at the position of the entrance in the now proposed design, I cannot help thinking that upper design very much bett as regards the entrances than the lower. I will guarantee as far as my experienc and observation goes, that that arrangement will give much more stillness than th other. Not only that, but so far as I can see, that design is calculated in the bes manner to give the largest area with minimum length of enclosed pier; and I am a loss to discover, which perhaps Mr. Druce will tell me, what the meaning of th very sharp corners is in both of these two designs; for as we all know your shar corner is a great expense in proportion to the small area enclosed. Conceiving the that those entrances are better designed, and that the general outline is mor economical, and the enclosure therefore more effectual for a given cost in the

upper plan, I should be extremely obliged if I were enlightened as to the merits in the other plans which have made it expedient not to adopt that upper plan, of which I knew nothing until I came to this room. I think we are very much obliged to Mr. Redman, who with his usual professional energy, and his usual research into the works of others, has given us his own ideas very luminously, and also put us in possession of the succession of ideas and plans which have been proposed for Dover Harbour. I believe that all the impediments and troubles we have about navigation from Dover to France, and Dover to the Continent is caused by the shallow, insufficient, bad entrance at Calais. I know that one or two successive Governments were perfectly aware of that; and it so happened that three days ago I got a letter from an eminent statesman in Paris, stating to me that I must not understand from the fact of the tunnel being promoted, that that had anything to do with the not creating a new and adequate harbour at Calais, and that there is every intention to create a deep water harbour at Calais, which they hope will be ready as soon as our harbour on this side is complete. No doubt that will be considered good news.

The CHAIRMAN: Captain Hoseason, will not you favour us with some observations? Dover is your child.

Captain HOSEASON, R.N.: I have said so much about Dover that I do not see what I should say more. All that I have advocated with reference to it has been supported by the first people of the country. I endorse every word that you and the talented gentlemen have stated as evidence before the Select Committee. You must understand my share in this transaction. I do not come here to propose any particular harbour. On arrival from the Continent, I found on my friend General Collinson's table a plan drawn up by the Harbour Board and Sir John Hawkshaw, on the part of the Railway Companies, which I think would have ruined the port of Dover. I entreated General Collinson to oppose it, pointing out to him the faults that I saw in this plan. I advocated that the harbour ought to commence beyond East Cliff jetty; and that plan is adopted by the Government, not because they entirely approve of it, but because it is all that they can do for the money. It is a case of £ *s. d.*, and if my friend, Sir George Balfour, who can deal so ably with finance, will only say, "Gentlemen, you have made rather a restricted harbour, we are willing to "give half a million more"—half a million will only give you ½*d.* on the Income Tax— "consequently we will give you the money if you will improve the harbour." Then we shall have a harbour to meet partly Mr. Redman and Mr. Scott Russell's views. Now, £970,000, to construct that harbour, is a very small sum; I doubt whether £970,000 will cover it, filling up that eastern entrance, which is 800 feet. I am not prepared to say, in that draught of water, what the expense of closing the aperture will be. No doubt the enclosure to the southward will be enlarged, and as that entrance is in deeper water, more expense will be saved in that part than on an equal quantity of shallow water. With regard to a question asked by Sir George Balfour, why, when the Government changed their plan of 1865, they opened the question *de novo*, I reply that they did so because there was a plan brought before them either to accept or reject, and they were forced to it by the Harbour Board and the Railway Companies. They did not go into it with any sympathy, for I think I can prove that the Board of Trade did not like the matter, but they were forced into it because they felt they must either let the Railway Companies and the Harbour Board do something, or do something themselves; and when they came to look into the matter, they found the funds at the disposal of the Railway Companies and the Harbour Board would not enable them to undertake any such enterprise as was necessary, and so the Government took it up, still limited in their funds. I think I have answered that question which was asked in Committee, and I think the only reason the Government did not go into a larger enterprise was that they felt the funds were restricted.

Lieutenant-General Sir GEORGE BALFOUR, K.C.B., M.P.: I came here to-night to get information on this very important national work, and I confess I have received it in a very full manner. Of course I need not say that it is not proper for me to express any opinion, one way or another, with regard to the practicability of constructing this harbour, seeing the position in which I at present stand with regard to the inquiry by the House of Commons; but I must say, the information which

Mr. Redman has given us, with regard to this project, is well deserving the attention of the Select Committee at present sitting on this harbour. I have also listened with great interest to what Captain Hoseason has said, and I may truly add that, if the Government consider it necessary for the defence of this country and the efficiency of our service, that they should form a harbour of this kind at Dover, it is incumbent on the country to provide the money to establish it. The question is, not only whether the country desires to have this harbour for the maintenance of our independence, but the next great question is as to the form of this harbour. I think I may say that the question of the present limited area of the harbour is entitled to great consideration. I have listened with great attention to what Mr. Scott Russell has said, and I think it well deserves the attention of the Committee now sitting on this harbour, as to whether its area of the extent proposed, of 310 acres, will make it that efficient port which we desire to have for our Navy, as well as in part for our commercial marine. Then, with regard to the form of the harbour. I think Mr. Redman has very justly and properly brought to prominent notice the various outlines of the Dover Harbour works proposed in former days. I think that the former very carefully prepared plans for the Dover Harbour works well deserve the attention of the Select Committee. Also, as to whether any suggestions could be derived from the former reports, which would make the present proposed harbour more efficient. I think this useful lecture is also extremely well deserving of Mr. Druce's attention, because, from having for twenty-five years held the important office of resident engineer, and superintended, on behalf of Government, the construction of the Admiralty Pier at Dover, he would be a very valuable witness before the Select Committee, well entitled to have the confidence of Government in any advice he may give. It appears to me to be important that we should ascertain distinctly, not only the maximum area in acres we need at Dover for the various purposes, but also at what cost per acre of area on the sum we are now prepared to expend, but also ascertain, according to Mr. Scott Russell's suggestion, whether with a small additional outlay the proposed area could not be so enlarged that we could get a much larger available area, and of increased depths in the areas or zones, at a much smaller rate per acre than we can attain with our present planned area and expenditure. These are all questions well deserving of the consideration of all engineers, and I hope some of the gentlemen who have spoken to-night may be summoned before the Select Committee, for the purpose of giving that information which will, if adopted, be invaluable to the nation. The suggestion Mr. Redman has thrown out, with regard to the collection of silt, or rather mud, well deserves the attention of the authorities. I am sure Mr. Druce will give his best consideration to it, and be prepared to show in what manner this very suspicious appearance of a large collection of mud close to the lee of the present Admiralty Pier will be likely to continue or be extended, in the case of the eastern pier being erected. These questions are well deserving serious attention, because they are not only questions of *£ s. d.*, but also involve the very existence of the harbour. I admit that, if the nation needs this harbour for offence or defence, then we should be prompt to expend the money required to attain our object. My caution is simply to ascertain whether, when the harbour is made, it will remain effective and not be silted up. I frankly avow that I should doubt at the present time whether the million of money proposed to be spent on Dover would not be better laid out on the commercial harbours of the kingdom, than in this one port, for I view, with great alarm, the dangerous state to which the commerce of this country is exposed from competition. I see foreign nations improving their commercial harbours, and affording such accommodation as to lead to an extension of their commercial marine. I, therefore, say to you frankly that, deeming our greatness to rest on the commercial prosperity of the country, you will see how important it is that the trading harbours of the kingdom should be made, in every respect, efficient and fit for our commercial industry. It is in that form we shall aid in maintaining our national greatness, and create the funds which we need for our defence. If we once lose that commercial superiority, you will allow that England will dwindle down to a very small nation indeed. Therefore, whatever difference of ideas I may have with regard to a military port at Dover, my friend, Captain Hoseason, knows well what my real views are. I need only say, that I

desire to obtain that which is best for the benefit and advantage of our country. In conclusion, I hope General Collinson, you will express, in suitable terms, the great obligation we must all feel, but especially that I feel, for the opportunity we have had to-night of obtaining the very valuable information with which Mr. Redman has furnished us, regarding this great national work of a naval and military harbour at Dover.

Captain HOSEASON, R.N.: Hearing from the General who has just sat down that he will avail himself of Mr. Druce's able assistance, may I suggest one or two others who can give most important evidence? I would point to Captain Morgan, who has been responsible for all the packets at Dover for years. He, I think, will tell you that there are certain gales during which the Government pier is no protection from either side, and that he has been out of bed, night after night, in intense anxiety, to know what to do with vessels, and that he has had occasionally to send them to the coast of France for protection. I wish, also, to call attention to Captain Bruce, who has, perhaps, more than any person out of England, made the passage to and fro. He will reiterate exactly what Captain Morgan will say. These are practical men, who can speak of facts ten times more effectually than I can.

The CHAIRMAN: Mr. Scott Russell has told us very properly that this is not the proper place to discuss questions of international polity, or political questions concerning the defences of the Empire; but still I think we may fairly say, as far as the discussions have gone, not only to-night, but on previous nights here, that there is a very general concurrence of opinion amongst both professions of Her Majesty's Service, that this is a very important question for the country, and that there are times when it should be taken up in a very serious manner. As regards my own opinion, not only in a naval and military, but also in a commercial point of view, as a harbour of refuge I do not think you can make Dover Harbour too large. Captain Burstal has told us about the state of the Downs, and I think Mr. Redman mentioned that the Downs in 1719, or thereabouts, was considered to be a troublesome anchorage, which vessels were frequently obliged to run from. I have heard the same opinion expressed in these days by gentlemen belonging to the Trinity House, that there is a great deal of trouble to the vessels lying in the Downs, in consequence of the numbers, and perhaps in consequence of their being badly found; that a good deal of damage is done by their fouling each other, and that, therefore, it would be desirable, if possible, to devise some remedy for it. Then, again, as regards the Downs as a good war anchorage, the question should be considered as to the power of coaling there. Captain Burstal mentioned with regard to that, the possibility of going round to the anchorage off Margate, where there is greater shelter and coaling there. I do not think myself, speaking as a military man, that it would be very wise in war time to trust to coaling at all in the open sea whatever necessities may call upon us to do, so I think it will be wise for this country to provide means of coaling in secure harbours, not only for the safety of the coal and of the vessels, but for the certainty and expedition of performing the operations. Mr. Redman has told us, in Henry VIII's time, it was proposed to spend about £80,000 upon the harbour. I cannot help calling attention to the great sagacity, boldness, and patriotism of the Government and country in those days in proposing such a scheme. When you look at the drawing upon that chart, you will see that for the ships then employed, and the circumstances of that time, it was quite as large a scheme as any that we are proposing now for our day. That £80,000, if it was really turned into money at the present day, would represent £800,000; and if you compare the population who were to pay that £80,000 with the population of this day, it would have to be multiplied again by about eight. I should think you will agree that that was a time we may rather imitate than later times, when smaller projects were thought sufficient.

Mr. REDMAN: I have already trespassed upon your attention so long that I have merely to thank you, and to thank the Council for the opportunity you have given me of bringing forward this paper: also to thank your Secretary, Captain Burgess, for the uniform courtesy with which I have been met by him. I take it there are very few points I have to refer to. My gallant friend, Captain Burstal, so entirely endorsed the views I have endeavoured to propound in that paper, that it leaves me little to say. Mr. Druce, my very old friend, naturally, with a reticence

which in his position I should feel myself, did not tell you so much as he migh
but the facts I have brought forward in this paper have not been disputed, and
have taken some trouble in arriving at them. He referred to the absence of shing
being caused by the accretion at Dungeness. Having been employed repeatedly c
previous occasions to make inquiries on such questions for the War Department,
can say, without any hesitation, that there are other causes intermediate betwe
Dungeness and Dover, which will fully account for the absence of shingle at tl
Admiralty Pier, because you must remember Dungeness was growing out in t
time of Elizabeth, when Lungley Point, westward of Dungeness, did not exist, ar
Dungeness has continued to progress seaward at the same rate up to now. I thi
the accumulation at Folkestone is quite sufficient to account for the action at Dove
In the same way, the observations that fell from Mr. Scott Russell entirely endor
the views I have advanced. He asked whether we could explain the reason of th
peculiar form of entrance now before a Select Committee of the House of Commor
I take it the circumstances of the case do to a great extent induce, that this soutl
west point, the end of the Admiralty Pier, is arrived at already, and is in fa
the south-west angle of the enclosure of 1844, and the Castle Jetty, near the nortl
east angle, was about the minimum frontage adapted to give 300 acres, and it, to
certain extent, fixed this south-east point (referring to the diagram), formed by tl
intersection of those two lines of east and south breakwaters. Undoubtedly, tl
observations of Mr. Scott Russell were quite correct, that there are conditions abo
that entrance, as shown by the deposited plans now before Parliament,[1] altogeth
inferior to the salient projecting angular entrance of the design of 1844, or S
William Cubitt's design of 1845. I have already trespassed too long upon yo
attention.

The CHAIRMAN: I have to request you to join in giving our thanks to Mr. Re
man for the great labour he has taken in placing so large an amount of useful info
mation before us. Although the audience has not been large, Mr. Redman mu
allow that it has been appreciative, and that it has brought forth a good deal
interesting information.

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[1] The two great questions in this really great and national one are—

1st. Is £1,000 per annum for dredging to be thought of as a bar?

2nd. Is the addition of one-third to the proposed expenditure of a milli
sterling, to obtain a proper outline, and commensurate area of enclosure, a
a salient well-designed southern entrance, to be weighed in the balance?

PRESERVATION OF BISCUIT AND OTHER FARINACEOUS ARTICLES OF DIET FROM WEEVIL, MAGGOTS, AND OTHER INSECTS IN H.M. NAVY.

Communicated by W. E. SECCOMBE, Esq., Controller's Department, Admiralty.

I NEED scarcely say that for a very long period it has been found that the biscuit on board H.M. ships, when in a hot and tropical climate, has been rapidly attacked and destroyed by weevils and maggots, often to such an extent as to render it very repulsive, and quite unfit for human food, sometimes causing large quantities of it to be thrown overboard, or otherwise returned to the victualling yards when the vessel arrives in England.

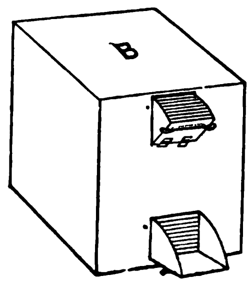
This damaged and worm-eaten biscuit has usually been sold by auction from time to time, as it has accumulated, for feeding cattle, &c.

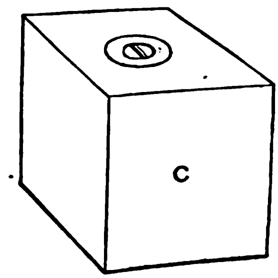
After the commencement of the annual sales, about four or five years since, the large *quantity* of biscuit which came to the hammer, as well as the worm-eaten condition in which some of it was found, attracted the special attention of the officials at the Admiralty, and it was considered desirable that some arrangement should be made to prevent so great a sacrifice of the very first-class biscuit, which is regularly manufactured at each of the victualling yards.

Having had the honour of being deputed by the authorities at the Admiralty to attend at these sales, I thought it was possible to stow the biscuit in iron tanks, hermetically closed, in such a manner as to make each tank in the bread-room easy of access; and at the same time to be so closely stowed in the vessel as to carry the full complement of bread for the ship's company as if it had been filled in bags in the usual way.

Having been requested to state the proposed mode of fitting the tanks, a rough sketch showing the form of scuttles for filling and emptying, &c., was forwarded, which obtained the approval of the proper authorities, and it was determined that three *trial*-tanks should be prepared at Deptford Yard (similar to sketch B), which should be filled with biscuit at Deptford, Plymouth, and Gosport Victualling Yards, respectively, and hermetically closed for twelve months, in

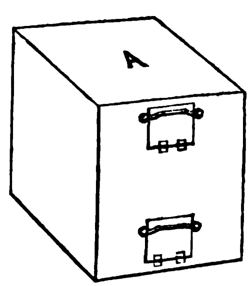
order to test the condition of the biscuit after being kept closely confined for the time named.





It may be observed that biscuit had been on several previous occasions put into iron tanks on board ships and in the storerooms at different stations; but, as a rule, it had mildewed and got spoiled, or had become infested with insects, which made some of the persons, who had considerable experience in these matters, somewhat fearful of the satisfactory results of the experiments about to be made; but the tanks formerly used were simply the old water-tanks with the manhole at the top, which necessitated the sending some one into the tank from time to time to get out the bread, which operation is, in itself, very disagreeable to persons eating the bread, while the constant opening and shutting the manhole (see sketch C), which is on the top of the tank, allowed any water falling on the tank to get into it, and the cover not being hermetically closed (and perhaps sometimes left off altogether) allowed the weevil to penetrate, and thus spoil the whole of the bread.

The arrangements of the fittings in the proposed experimental tanks were as follows:—Sketch A shows the upper scuttle for filling, and the



lower one for emptying, closed up and screwed tightly. The upper scuttle turns down to an angle of 45° with side flaps turning up (as shown in sketch B), the biscuit falling naturally out of the mouth of the bag into the tank. The lower scuttle, as will be seen, falls down level, and the biscuit is drawn out with a small rake into bags as required, the whole contents of the tank falling down naturally until most

of the upper part of the tank is emptied, when that at the bottom is drawn out by the rake as before. When about to fill the tank, the bottom scuttle is first screwed home tightly and joint puttied up, like the mode of securing an ordinary pane of glass, and after all the bread is put in, the upper scuttle is closed and hermetically sealed in like manner; and, in taking out the bread, it is only necessary to clean out the putty, turn down the lower lid, and take out what is required, when the lid must be again turned up, screwed home, and re-puttied.

The inside of the tanks is coated over with hot lime-wash, fixed with about three-quarters of a pound of coarse sugar to each gallon of wash, which keeps the lime from coming off and forms a good wholesome coating.

As before stated, the three experimental tanks, when completed, were examined, and approved by the Constructors' Department and Superintendent of Victualling. One of the tanks was retained at Deptford, and the others sent to Devonport and Gosport Victualling Yards, where they were filled with the newest bread that could be obtained, and hermetically closed up (as before described), in the presence of the Officers of the yard, the bread being carefully weighed before being put in, and a record kept of the weight.

The tank at Deptford, as well as the one at Devonport, was filled with biscuit only about two or three days old, but at Gosport the *newest* biscuit in store was several weeks old, which was accordingly put into that tank.

The tanks were filled in the summer of 1871, when the moth and weevil were very plentiful, and the experimental tanks were put into the condemned bread store, where large quantities of infected biscuit were stowed in bags, the weevil, moths, and maggots abounding at that season all over the loft, and crawling in and out of the open pores of the biscuit bags, which were kept stowed there, as it arrived from the ships, in order to await the annual sale.

If therefore (as some parties stated) the weevils, maggots, &c., bred naturally in the biscuit when stowed in closed iron cases at a high temperature, there was every opportunity for their so doing in the tanks during the summer weather, but if (as seems most reasonable) the moths and weevils fly about from place to place, and deposit their numerous eggs in the bags of new bread, they have ample opportunity for so doing, as in the store lofts, where the bags of *new* bread are stowed, the windows are usually open for ventilation, and these insects can fly in or out at pleasure, as they undoubtedly do, and thus corrupt, in a short time, the good bread. This was clearly to be seen in opening the Gosport tank, after the twelve months had expired, for, while the tanks at Deptford and Devonport, when opened, had not the slightest sign of insect life (the biscuit with which they were filled being all fresh baked), that at Gosport, where the bread had been lying in bags for some weeks before being put into the tank, showed very clear indications of maggots having crawled over the biscuit, and several live maggots were found, although they seemed in a weak condition, and had in no instance bored into the biscuit. It was, however, very manifest that, for lack of air, the maggots had

not in any case changed into the chrysalis state, nor were there an moths visible, which shows that there is no danger of further propa gation, even if the young maggots are formed, after the tanks ar hermetically sealed.

I would also observe that at the time of filling the tanks at th Royal William Victualling Yard, Devonport, I took an opportunity c putting, into large tin cases, some of the weevilly biscuit in whic were hundreds of these living insects in different stages of existenc also I took from the windows, where the live weevils were crawlin and flying about in large numbers, some scores of them and place them in among the others, putting in a quantity of sound biscuit fc them to subsist on, and then hermetically closed them up; on re moving the lid of these tin cases after being closed twelve month *not one* of the weevils was alive, and it would appear that they ha not lived long after being closed up, for the weevilly biscuit showe no signs of being more full of holes than when put into the ti while the sound biscuit was perfectly free from their ravages, a when first put in, plainly showing that weevils will not live if sh in from the air, so that if new biscuit is slightly affected with weevi if, at once, it is hermetically closed up, it prevents the further inju of the biscuit. It must, however, be carefully arranged to have tl biscuit perfectly dry, and thus ensure its freedom from mildew, whic is sure to take place if the bread gets damp from any accidental cau before it gets into the tank, but once in the tank, however damp tl external atmosphere from foggy or wet weather, steam, &c., it will l perfectly free from its influence, and come out lighter than when went in; this was specially manifest in all the experimental tank where the bread weighed about *one* per cent. lighter than when it w put in.

I would also remark that in the event of a vessel shipping a sea, or a fire occurring on board requiring water to be largely thrown abo in the vicinity of the bread rooms, when, from smoke or steam, both combined, the bread, if stored in bags, would be sure to spoiled, the tanks would effectually keep it safe from injury, exce the fire were so fierce as not to be got under; also, if fire shou occur, and only a very short time be available for getting out pr visions into the boats, one of the iron cases, or smaller tanks m without ceremony be pitched overboard, or, if time permit, be lower with a rope, as the cases would swim, and the biscuits be taken out leisure, or the "cases" may be stowed away in the boats, where could be kept dry for use, however rough the weather may be.

At the time of the opening of the experimental tanks in the pr sence of the Officers of the yard, a sample of the biscuit was sent t the Admiralty with an elaborate report, which on the whole was co sidered to be so satisfactory that it was determined to fit out on vessel of each class with these tanks.

It was, however, afterwards considered that some of the smalle class vessels going out to tropical stations would be the best tes and accordingly the "Dart," 570 tons, was so fitted and sailed to th south-east coast of America, in June, 1872; next came the "From

592 tons, composite gun boat, fitted at Chatham, which went to China, on her first commission, early in February, 1873, afterwards the "Amethyst" corvette of 1,405 tons, was so fitted at Devonport; also on her first commission, this vessel went to the south-east coast of America and West Coast of Africa, about August, 1873, and lastly came the "Victor Emanuel," of 3,087 tons, which was fitted at Portsmouth as a hospital ship for the troops, which went out to the Ashantee war, her tanks, 16 in number, contained 20,000 lbs. of biscuit. She sailed for the seat of war on the West Coast of Africa, in November, 1873. Other vessels are now in course of being fitted, viz., "Undaunted," frigate, "Diamond," and "Sapphire," corvettes, also "Juno," and "Wolverine," while other vessels are being considered which are intended for the reliefs on foreign stations during the next year.

Satisfactory reports have been received from each of the vessels, as to the condition of the biscuit. The captains of the ships were directed to forward a detailed account of where it was obtained, the date when each of the tanks was filled, and when emptied, together with the *condition* of the bread on these occasions; the report to be forwarded to their Lordships every six months during the commission.

The first report from Commander Denny, Her Majesty's ship, "Dart," of 22nd May, 1873, after about eleven months' trial, stated "that the biscuit was good, dry, and free from weevil, almost as good "as when put into the tanks." The second report from "Dart," 25th May, 1874, said "that the *service* bread stowed in tanks was very "good. What was obtained from contractor good, *in some cases*, but "in others attacked by mildew, but yet *better* than if kept in bags." I may here observe that the remarks respecting the bread obtained from *contractors* on foreign stations is quite in keeping with the general experience of Officers commanding Her Majesty's ships, respecting the use of this sort of biscuit which is often made of inferior flour, or adulterated with pea-meal, and other deleterious ingredients, added to which it is not dessicated in the very satisfactory manner in which our *service* biscuit is prepared, and hence the great difficulty experienced in preserving this bread; the proposed *remedy* for this will be treated further on.

The first report from Commander Buckle, Her Majesty's ship "Frolic," China station, 30th June, 1873, stated that "the iron cases "keep the bread in excellent preservation and entirely free from damp "and decay, not the slightest sign of maggot or weevil having yet "been observed," but report also stated that tanks fitted with lids for "filling and emptying were best, as the experimental potato cases "were too slight and got broken, and had to be thrown overboard."

The second report from "Frolic," dated 31st December, 1873, stated that these cases keep the biscuit in excellent condition, not the slightest sign of decay or weevil has been discovered in any of the biscuit so protected; biscuit which has been eleven months in the ship is as good as when put on board. Mention is also again made of the slight material of which potato cases were made, advising their being not quite filled in future, in order to prevent their bulging out,

also advising that only *half* the bread-room may be filled with cases This last recommendation, however, is considered not advisable, as it would necessitate about six weeks stock being put into bags, which is double the quantity that is deemed safe so to dispose of, as the weevil in two or three weeks, in a tropical climate, has been known to get a large hold on the bags of bread exposed to their ravages. A report was received at the Admiralty from "Amethyst," dated 30th June 1874, stating that the bread-room fitted with hermetically sealed iron tanks, has answered well, and the bread appears to keep in better condition than when stowed in bags in the ordinary manner. A second report from the "Amethyst," was received after more than twelve months' trial, which stated that "the plan has hitherto answered very well, "the biscuit received in England being as good now as when put on "board." A remark was also appended, "that the process of filling the "tanks occupies more time than stowing bread in the ordinary way." This, of course, must of necessity be the case, but is of little moment compared with the advantages of the ship's company being constantly supplied with perfectly sweet and wholesome bread.

A report from Captain Parkin, Her Majesty's ship "Victor Emanuel," dated Hong Kong, 30th November, 1874, arrived at the Admiralty early in the present year, which said that "the tanks have been most "successful in preserving the biscuit, notwithstanding the heat and "closeness of the atmosphere at Cape Coast Castle, and the various "temperatures passed through during the passage to China, the "biscuit came out as fresh and sweet as when received from the "victualling yard, and perfectly free from insects. The tanks have "been removed from the ship, and will be used for storing bread at "Hong Kong Victualling Yard. The reason why the tanks have been "removed is, that the vessel is brought near the jetty, and soft bread "will be used while she remains in that position."

The Paymaster's report from "Victor Emanuel" is to this effect:— "The biscuit was as fresh and sweet as when received from the "victualling yard, not the sign of the weevil or any insects. I "consider the tanks an excellent arrangement for preserving the "biscuit."

It therefore appears clear that, if biscuit thoroughly desiccated as that is which is so well manufactured in our victualling yards, is put into tanks and hermetically closed, even in the hurried manner in which that was got on board for the Ashantee expedition, it is perfectly safe from harm, either from heat or moisture; as when the joints of the scuttles are puttied, they are quite water-tight as well as air-tight. Bad smells, therefore, arising from exhalations from bilge water, or other causes on board ship, will not affect the biscuit in any way, neither are those pests of a warm climate—the cockroaches—able to get anything to feed on, as they constantly have when the bread is kept in bags, and they are, therefore, far less likely to propagate. And even in our more temperate climate, where the weevil is seldom seen, it would seem very desirable that the bread should be put into tanks, because the ravages of rats and mice in the open bread-room, when the biscuit is stowed in bags, is something very considerable, and causes large quantities of

it to be annually thrown away, to say nothing of the disagreeable idea often pervading the mind, that large numbers of these vermin are running over the bread, leaving their droppings, &c., to the great disgust of those who are obliged to subsist on the biscuit.

In using the tanks, there will also be a great saving in the quantity and cost of bags, which, when stowed in bulk in the bread-room, rot very fast from damp, &c., while the tanks, if painted on the outside once a year, with white enamel paint, will last twenty or thirty years, for the internal coating of lime and sugar effectually prevents rust in that direction.

With regard to the foreign victualling stations, where biscuit is manufactured on the spot, if the climate is tropical and the bread is left *in bags* for any time after it is fully desiccated, nothing can prevent the weevil and maggot from destroying it, but if put into tanks, of the desired construction, as soon as it is properly desiccated, and then allowed to cool, it may be kept perfectly sweet for years, and can be taken out from the lower scuttle into bags (a few bags of finer texture should, however, be used for this purpose, through the pores of which the weevil could not enter), and the biscuit may then be conveyed on board the ship and immediately put into similar tanks fitted in the bread-room of the ship, and biscuit thus treated will assuredly keep in good condition as long as may be required.

With regard to those foreign stations where the bread is *not* made on the premises, but simply stored, as received from England, I would observe that large quantities of biscuit have been condemned, from time to time, at these places, from the ravages of weevils and maggots, produced from the eggs of the moth. From the valuable report of Mr. Rowsell, Director of Contracts, after personal inspection and from information he obtained on the spot, it appears that at Gibraltar, not long since, 390,000 lbs. of biscuit were condemned in five months, also 19,000 lbs. condemned on board "Hercules."

It has been sometimes customary to send out the biscuit to foreign stations in ordinary water tanks, but they have failed to prevent the maggot from spoiling the bread, because they were not hermetically closed, also casks have been used in many cases, these, from the shrinking of the staves, have either let in the water which happened to fall on them (when all mildewed together) or the weevils being very small, have got in through the joints and destroyed the whole contents, which occurred in the store at Jamaica not long ago, where 27,000 lbs. were condemned as unfit for human food.

To insure success in keeping a stock to meet the wants of the shipping, it will be only necessary to have a good supply of store-tanks (similar to that which has been lately put into the Victualling Yard at Hong Kong, from the "Victor Emanuel," late Hospital ship, specially fitted for Ashantee War); and as to means of transit, the bread can be taken out from England in tanks so constructed as to have shifting lids, the whole size of the top, to be screwed up when filled with bread, and then hermetically closed by using putty in the joint, and afterward pasting over it a strip of calico or Chinese paper. These tanks, which, when full, will contain

20,000 to 30,000 lbs. of bread, can be made to fit into each oth when empty, so that about twenty tanks may be brought home agai for re-filling, at a mere nominal cost, viz., the tonnage due to tl cubic contents of the largest tank, together with the bulk of tl covers standing one on the other. The cost, therefore, of returning tl "empties," which has been the principal objection to sending tl bread out in tanks, or in tin-lined cases, is reduced to a mere trifle, an the *cost* of sending it out would be more than made up by the entii freedom from condemnations of bread, as heretofore, to say nothing c the comfort and satisfaction of the Officers and crews of Her Majesty ships, in not having to eat the unwholesome foreign-made bread, nc even to be subject to make use of the otherwise good "service" brea when made loathsome by maggots and weevils.

It should also be observed that the ravages of the weevil in the pr vision-rooms of Her Majesty's ships, are not altogether confined to tl biscuit, for all farinaceous articles of diet, such as flour, oatmea pearl-barley, rice, &c., also chocolate, when stored in casks and ope cases, are often attacked and destroyed, so that they are condemne and sold at considerable sacrifice; this may be entirely prevented l having the smaller tanks, in which these materials are stored in tl issuing room, fitted on a similar principle (although somewh modified) by having the lower scuttle (which will require openin several times a day), fitted with a strong spring latch to close u tightly on a thin slip of india-rubber, so as not to require to be lute with putty in order to make it air-tight.

I have thus endeavoured shortly to explain the mode which ha to a considerable extent, proved efficacious in preserving the biscu in Her Majesty's Navy, as well as to point out the further propose method of supplying the various foreign stations; and, I doubt not, the scheme be fairly worked, that in a short time the condemnation c biscuit in Her Majesty's Navy (except from accidental causes, ov which there is no control) will be a thing rarely known.

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LECTURE.

Friday, February 12th, 1875.

Major-General Sir GARNET J. WOLSELEY, K.C.B., G.C.M.G., &c., &c., in the Chair.

MILITARY BRIDGE-CONSTRUCTION.

By Lieut.-Col. Arthur Leahy, R.E.[1]

When a nation has decided to be prepared for war, the indispensable conditions are—

1. To enrol and train men to fight.
2. To provide *matériel* for their equipment.
3. And supplies for their maintenance.

These conditions being fulfilled, and war being decided on, one of the first military points which will necessarily come under the consideration of the General appointed to direct the war, is the *communications* of his Army; this consideration will, when the General is free to choose the theatre of his operations, largely influence his choice, and when not so free, the establishment and maintenance of his communications will be his first care. By communications are usually understood roads, railways, canals, and telegraph lines; but in the case of an insular power the first communications for the purpose of offence, are necessarily exceptional, and are established and maintained by the Navy.

It is one of the functions of an engineer to direct the works necessary for establishing and maintaining the first mentioned communications, and of these works none are of greater importance than bridges; hence it arises that "military bridge-construction" is one of the duties which a proportion of every military force should be specially trained to undertake.

In our own Service the subject has not, until a comparatively recent date, received the attention it deserves. Our recent wars have happily

[1] The publication of this lecture has been unavoidably delayed.

not been near home, our first lines of communications have been pr vided by our Navy, and in the only European expedition in whic within the last 60 years our army came into collision with that of Continental Power, we did not move a dozen miles from our ship Yet who can read of the expedition to the Crimea without being in pressed with the fact that many precious lives and much treasure wei unnecessarily expended from the want of means, prepared beforehan for establishing and maintaining our military communications. By happy chance no serious inconvenience resulted from the want of military bridge-equipment, for although no important rivers ran acro the track of our Army, and the streams which had to be passed wer partly owing to the season of the year, in many places fordable, y had the bridges which did exist, been demolished, and the fords bee obstructed, the case would have been very different. I can testify t the anxiety that was felt when, entirely destitute of any bridge-equip ment, we approached those streams; and I do not hesitate to say tha had resistance been offered to the crossing of the Belbec and Tchernay and the aqueduct parallel to the latter stream, we should have bee much embarrassed from want of preconcerted means for passing troop across a few yards of deep water.

There is not any speciality that has, throughout the period fro which military history dates, preserved its importance more constantl in relation to the operations of war than "bridge-construction."] influenced such operations ages before many of the arms and ap pliances now in use were thought of, and the necessity for its stud and practice is now as great, if not greater, than ever.

In railways a new element of immense military importance ha arisen, and I need scarcely say that for railways, bridges are more in dispensable than they were for any pre-existing communications.

Military bridges are of two classes—

1. Those formed on floating supports or piers.
2. Those of which the supports are fixed.

They may be wanted to complete the communications of an arm where no bridges exist, where permanent bridges have been destroyed or require to be supplemented either with the object of separating th combatant troops from the baggage of an army, or because the road or tracks leading to the bridges, admit of the advance of troops on larger front than the width of the permanent structure.

In such cases, one or more temporary auxiliary bridges may be wanted for each road, and these, by increasing the means for rapid movements,—now so essential in military operations,—may contribute largely to success.

It would be beyond the scope of this lecture to dwell at any length on the influence of bridges on strategic or tactical operations, and I can, therefore, only call attention to a few important examples of bridges which have been constructed for military objects.

The first military floating bridge of which we have any detailed account, is that constructed by Xerxes more than 2,355 years ago, and over which his host, estimated at above five millions of souls, were, during seven successive days and nights, marched into Greece;

but this, however, would appear to have been preceded by other important bridges constructed by the Persians across the Thracian Bosphorus, and the Danube.

The bridge across the Hellespont was about 1½ miles long; there were two roadways, one formed of 360 ships or boats, the other of 314. One of these roadways was set apart for the combatant troops and the other for the attendants and baggage animals. In each case the vessels were connected by enormous cables, stretching from shore to shore, which were tightened by windlasses on either side, and superlaid with planks, brushwood, and earth, formed the roadway. It may not be without interest to some of my military audience to remind them that the first attempt to construct this bridge failed, owing so far as I can discern, to the neglect of one of the simple principles of bridge-construction, and that this first failure cost the bridge-constructors their lives.

We also read in Xenophon that Cyrus found bridges across the Mæander and Tigris, the former being composed of 7, the latter of 37 boats.

Skins inflated, or filled with hay, were used for crossing rivers by the Greeks, notably by Alexander the Great for the passage of the Oxus. Casks were used by the Romans on several occasions for a like purpose. It was also customary for the Romans to carry with them small boats, together with planks, nails, and ropes, for crossing rivers without loss of time.

Of fixed bridges, the first notable example is that constructed across the Rhine by Cæsar. I produce a model showing how the trestles of this bridge, which was of great strength and solidity, appear to have been put together. It took ten days to construct.

There are numerous instances in which the Rhine has been bridged for warlike operations.

The passages of that river, for purposes of attack by Jourdan in 1795, and by Moreau in 1797 and 1800, are celebrated.

Moreau's passage in 1797, is stated to have been one of that great General's most remarkable enterprises, and was thus effected:—

His Army, some 60,000 strong, shared with that of Hoche, some 70,000 strong, the possession of the left bank of the Rhine from Kehl to Dusseldorf, and the two Generals were ordered to operate simultaneously against the Austrian forces on the right bank in order to create a diversion in favour of Napoleon, then engaged against the Austrians in Italy. Hoche crossed the Rhine without difficulty at Nieuweid, where he had a footing on the right bank, but Moreau had to cross in face of the enemy.

He therefore collected about 60 boats, 40 of which were brought down the Ill, on the dark and stormy night of April 19–20, 1797, with the intention of being used to pass troops across the river at dawn, and thereby surprise the Austrians. The boats were, however, delayed by grounding on a sand bank, and only 25 were forthcoming at 5 A.M., on 20th April, when a fresh delay arose. In the Ill, which was shallow, the boats were poled along. The oars, necessary in the Rhine, had been stowed in one of the boats which had grounded.

An hour was lost in procuring them, and meanwhile, the idea of surprise had to be abandoned.

The French flotilla, on arriving at the Rhine, found itself in view of the Austrian batteries, which commenced to fire on it. The pontooneers, however, who managed their boats with skill and coolness succeeded in landing the troops out of grape-range, and went back for other detachments. The French troops sustained themselves on the right bank until reinforced by troops, thrown across:—1stly. By a flying bridge, which was subsequently destroyed by artillery fire. 2ndly. By a floating bridge constructed between 6 P.M. and midnight on 20th April. This latter bridge was, with difficulty, formed under artillery fire from the Austrian batteries.

When this bridge was completed, the troops of Moreau's Army were in a position to take the offensive, which they did, and the operation ended in the retreat and route of the Austrian forces.

The military history of the 17th, 18th, and of the early part of the present century, abounds in examples of important uses made of military bridges. I will now only mention a few of those which appear worthy of special notice.

A bridge 380 yards long, constructed across the Danube at Deckendorf (1740), remarkable for being withdrawn by wheeling it entire along the bank ("swinging bridge" is the technical term used) after the rear-guard of the Army, when closely pressed by the enemy, had crossed it in retreat.

The bridge across the Limat, between Lake Zurich and the Aar, formed (1799), in two and a-half hours, under fire of a Russian force. The bridge was about 100 yards long, and the operation was covered by a detachment previously sent across the river in row-boats.

At the same time Soult forced a passage across the Linth, between Lakes Zurich and Wallenstadt, his troops being passed across on flying bridges, covered by a selected company of expert swimmers, who had been trained to swim, armed with pistols and sabres.

In the spring of the following year (1800), Moreau forced a passage in the face of Austrian troops, across the Rhine, near Lake Constance, a little below Stein. It was intended to have formed the bridge at night, but owing to delay in the arrival of troops, this was not possible, and the bridge was made in the early morning, under cover of artillery fire. By 9 a.m., all Moreau's corps, numbering three divisions and a reserve of cavalry, had passed over it, and were formed on the right bank. In this case the pontoons were carried by hand over ground not practicable for wagons, and the operation is remarkable as showing the importance of having a bridge-equipment capable of being used as boats, and at the same time not too heavy to be carried by hand.

The bridge constructed in 1814 across the Adour, from the left wing of the Duke of Wellington's army, and of which there is a model in this institution, ranks high in importance and interest. It was constructed of boats and cables, on the same principle as the bridge of Xerxes already described.

The passage of the Berisina, during the retreat of Napoleon from

Moscow in 1812, affords one of the most remarkable instances of the importance of maintaining a bridge-equipment as part of the materiel to be moved with the advance of an army, and is also an example of valuable services rendered by Pontooneer corps in constructing improvised bridges under circumstances of peculiar difficulty.

During the month of November, 1812, Napoleon, in his desire to reduce to a minimum the inconvenience of a long train of baggage, ordered a large number of wagons to be destroyed.

Among these was included his pontoon equipment, which, against the remonstrance of General Eblé, the Officer charged with the direction of the bridging operations of the Army, was burnt.

General Eblé, foreseeing the difficulties likely to arise from this proceeding, gave orders that every pontooneer should carry with him some kind of implement, or nails, useful for bridging operations, he also managed to retain two forges and six wagons, containing tools and ironwork, from the wreck for his train, and, with remarkable foresight, he added some charcoal for his forges.

Napoleon's march was directed to the Berisina, and he made his plans to cross that river by the bridge at Borisow, which was then held by his troops; but, on 23rd November, he received the news that his troops had been repulsed, and that the Russians were in possession of the bridge which they afterwards burnt.

The Russians, who were in great strength on the right bank of the river, expected that Napoleon, checked at that point, would endeavour to pass the river below Borisow, and directed their attention to the lower Berisina, while Napoleon, with great judgment, decided to attempt the passage some leagues higher up.

On the 24th November, Napoleon sent for General Eblé and explained his plans. The Berisina, at the point where the passage was decided on, was less than 100 yards wide. The greatest depth was from six to seven feet, the bottom was muddy, the current moderate, and loose ice drifting down.

Had one-tenth of the bridge equipment which had been burnt a few days before, been available, the passage of the river would have been a simple matter.

In the absence of this equipment, bridges had to be improvised, and had it not been for the foresight of General Eblé, this would have been impossible.

It was decided to construct two trestle bridges; one a light bridge for infantry, and a stronger bridge for artillery and for baggage.

General Eblé lost no time in setting his pontooneers to procure materials for the bridges from the neighbouring village of Studianka. Trees 16 to 17 feet long and 5 to 6 inches in diameter, and timber procured by the destruction of the village, were the available materials.

By about 5 P.M. on 25th November, 46 trestles were prepared, 23 for either bridge. In order to place the trestles, the pontooneers had to work by night in the water, the ice forming around their limbs, adhering to their flesh and causing intense pain. By 1 P.M. on the 26th November, the light bridge was completed, just in time to enable about 7,000 men to be passed over the river, to hold in check the

advance of the Russian troops, who, on the discovery of the attem] had begun to move towards the point at which the bridges were bei erected. The flooring of this bridge was formed of light planks tak from the houses, and it was barely passable for horses. A few lig guns and some ammunition-wagons were, however, passed over hand.

By 4 P.M., the bridge destined for carriages was completed, and t artillery and other wagons began to cross. Many of the trestles a the roadway of this bridge were composed of round timber rude fitted with axes, and the movement of the carriages on so rough surface, and the pace of the horses, which, notwithstanding orde that had been given to the contrary, were permitted to trot, caused tl most violent shocks to the bridge. The trestles sunk unequally in tl muddy bottom and eventually some of them gave way, and the traf was several times interrupted.

The pontooneers worked by reliefs throughout day and night, a with wonderful devotion and endurance of cold and fatigue, manag to repair the bridge, so that during the 27th and 28th November, tl troops and a number of followers, and a portion of the baggage of tl Grand Army, were, notwithstanding the attacks of the Russians both banks of the river, passed across in safety.

Segur, writing of this exploit, observes that the exertions of tl pontooneers "sauva l'Armée," and Thiers says of General Eblé, wh with a large number of his devoted pontooneers, shortly afterwar succumbed under the hardships they had endured, that he crowned h career by an immortal service. ("Allait couronner sa carrière par " service immortel.")

Russian War, 1854–6.

During the war with Russia, 1854–6, floating bridges were ma use of to cross the Danube. A raft-bridge with carriage and footw was formed by the Russians near Galatz.

A bridge of boats 970 yards long, was formed, by detachments British and French engineers and British sailors, between Rustchu and the Island of Mokan, and a trestle bridge connected the lat island with the main land. Over 100,000 men crossed and re-cross this bridge.

The raft-bridge thrown across Sebastopol Harbour with remarkal rapidity in August, 1855, and removed in the following month aft the garrison had retired by it, was 1,000 yards long and 17½ feet wi It enabled the Russian reserves to be kept secure from the effects the fire of the siege guns by day, while at the same time they were hand in case of assault, or for purposes of night attack.

During the embarcation of the British and Sardinian forces Balaclava Harbour, numerous cask-bridges were formed between tl ships and the shore, by which troops, horses, and stores were broug up to the ships' sides, and the embarcation was thereby very mu facilitated and expedited.

Indian Mutiny, 1857–9.

The river Ganges was on three separate occasions crossed by the Oude Field Force during the rainy season of 1857.

July, 1857. On the first occasion the troops were ferried across in boats, an operation which took eight days.

August, 1857. On the second occasion, the distance was shortened by the construction of a causeway and pier a mile in length, and three bridges, of four, six, and twelve boats across some narrow channels, and the actual passage of the river was completed in one day.

September, 1857. On the third occasion, the communication was completed by a bridge, 1,090 feet in length, composed of 74 boats with improvised superstructure, anchors, and cables. It was constructed by undisciplined workmen and labourers, under the direction of engineer officers, in 42 working hours. In this case the force marched across in a few hours.

Italian War, 1859.

A bridge of 97 river boats was constructed under the orders of Prince Napoleon, on the Po, at Casalmaggiore.

American Civil War, 1861–63.

From the Civil War in America, 1861—63, may be dated a new era in military bridge-construction. In that war for the first time, arose the necessity for the hasty restoration of railway bridges in connection with military operations; and of the works carried out, the most notable is the trestle bridge across the Potomac Creek on the Richmond, Fredericksburg, and Potomac Railway. This bridge, the trestles of which resembled the model before you, required in some places three tiers of trestles, each about 20 feet in height.

This and most other forms of military railway and other kinds of temporary bridges, are fully described in the valuable work on Military Bridges, published in 1864, by Colonel Haupt, formerly chief of the Construction-Department of Military Railways in the United States' Army.

In this text book, much of the technical information given by Sir Howard Douglas is reproduced corrected to date, and with the addition of the important experience of the author.

The general success which attended the bridging-operations of the Americans during the Civil War, is admirably illustrated by an exceptional case of failure producing most serious results. This occurred when Burnside crossed the Rappahannock, in face of Lee's position overlooking Fredericksburg, with a view to making a direct attack on the Confederate lines, and, as is well known, one of the most crushing defeats of the war, entailing a loss of over 10,000 men, there occurred.

General Franklin, one of the corps' commanders, on whom the most important share of the action fell, officially stated before a Committee of the Senate, held at Washington:—That this disaster resulted from the delay in the arrival of the pontoon-bridges, and that whoever was

responsible for this delay, was responsible for all the disasters which followed.

Danish War, 1864.

During the Danish War, 1864, a bridge, 280 yards long, was constructed over the Schlei in $2\frac{1}{4}$ hours.

Troops were also thrown across to the Island of Alsen at night, *under fire*, in rafts each of two pontoons. Light artillery was also taken on the rafts.

The crossing took place at four stations, where the river was respectively 700, 900, 1,000, and 2,500 paces wide.

Austrian War, 1866.

Previous to this war, Prussian Officers had reconnoitred and measured the permanent bridges likely to be destroyed, and materials for their repair were prepared and fitted together beforehand.

Some of the bridges were subsequently repaired with these materials.

After the battle of Sadowa, the Austrian Army under Benedek, was saved from ruin by 6 strong pontoon bridges thrown across the Elbe, in the rear of the position.

German War, 1870–1.

The important services rendered by the bridge-trains attached to the German Army corps during the war of 1870–1 can best be appreciated by a glance at the Table in the Appendix which gives particulars of some of the bridges actually constructed.

The first important occasion on which bridges were required, was at the battle of Wörth. Early in that action the necessity for providing means of crossing the Sauer arose, but the bridge train of the XI Army Corps had, against the remonstrances of the Commanding Officer of Engineers, been left in the rear.

Delay and loss consequently occurred in crossing the river; foot-bridges were, however, improvised out of hop poles, and later in the day regular bridges were constructed, the pontooneers were, during the construction of these bridges, harassed by sharpshooters in the neighbouring houses.

Ashantee War, 1874.

It is exactly one year since, in our latest war, Sir Garnet Wolseley recrossed the bridge over the Prah, after the capture of Coomassie.

The events of that war are fresh in your memories, and were a few months ago graphically described at this Institution by principal actors therein.

The total number of bridges constructed during the war, was over 250.

I invite attention to the examples of bridge-construction used, of which models and diagrams are before you. These bridges were, as it is right they should have been, simple in character; and they were not required to carry any very heavy loads. Merit, greater than often attaches to more extensive works, is, however, due to the bridge-con-

structors, under whose direction the bridges were erected, inasmuch as they were put up under difficulties of no ordinary kind, with very small means both in men and materials, and with few of the appliances usually considered necessary for such works.

Of the bridges constructed during this war, by far the most important was that across the Prah, and the following account of the arrangements made for its construction has been given by Lieut.-Colonel Home, C.B., the Commanding Royal Engineer of the expedition:—

Bridge across the Prah.[1]

On arriving at the Prah, it was found that the stream was 189 feet in width, the depth varying from 3 to 10 feet.

Four small Blanshard's pontoons were the only means available for crossing, and were far too few to rely on, for the vast number of carriers that had to pass to the front.

Twelve trussed-girders, each 30 feet long, had been prepared at Chatham. These were very light and strong, and, with 5 supports, would give a bridge across the river 2 feet 6 inches wide.[2] But considering the very important link in the communications this bridge would be, it was determined to make it not less than 5 feet wide.

Thus, the trussed-girders would give one-half of the roadway required, and the remainder consequently had to be made up of material to be procured on the spot.

At Cape Coast Castle, some light trestles had been prepared, but examination showed that they would not be nearly strong enough.

A section was made of the river which showed that the bottom was fairly regular, and of hard sand. There were no means of driving piles, and such light trestles as the tackle on the spot would get out, would undoubtedly be carried away in a short time, as the current was running nearly four miles an hour, and freshets were to be expected.

Under these circumstances the use of crib-work piers was determined on.

On the 26th December, 1873, a rope was got across the river, so as to haul the pontoon-rafts backwards and forwards. This rope served also to keep off any drift-timber that might float down the stream, from damaging the bridge.

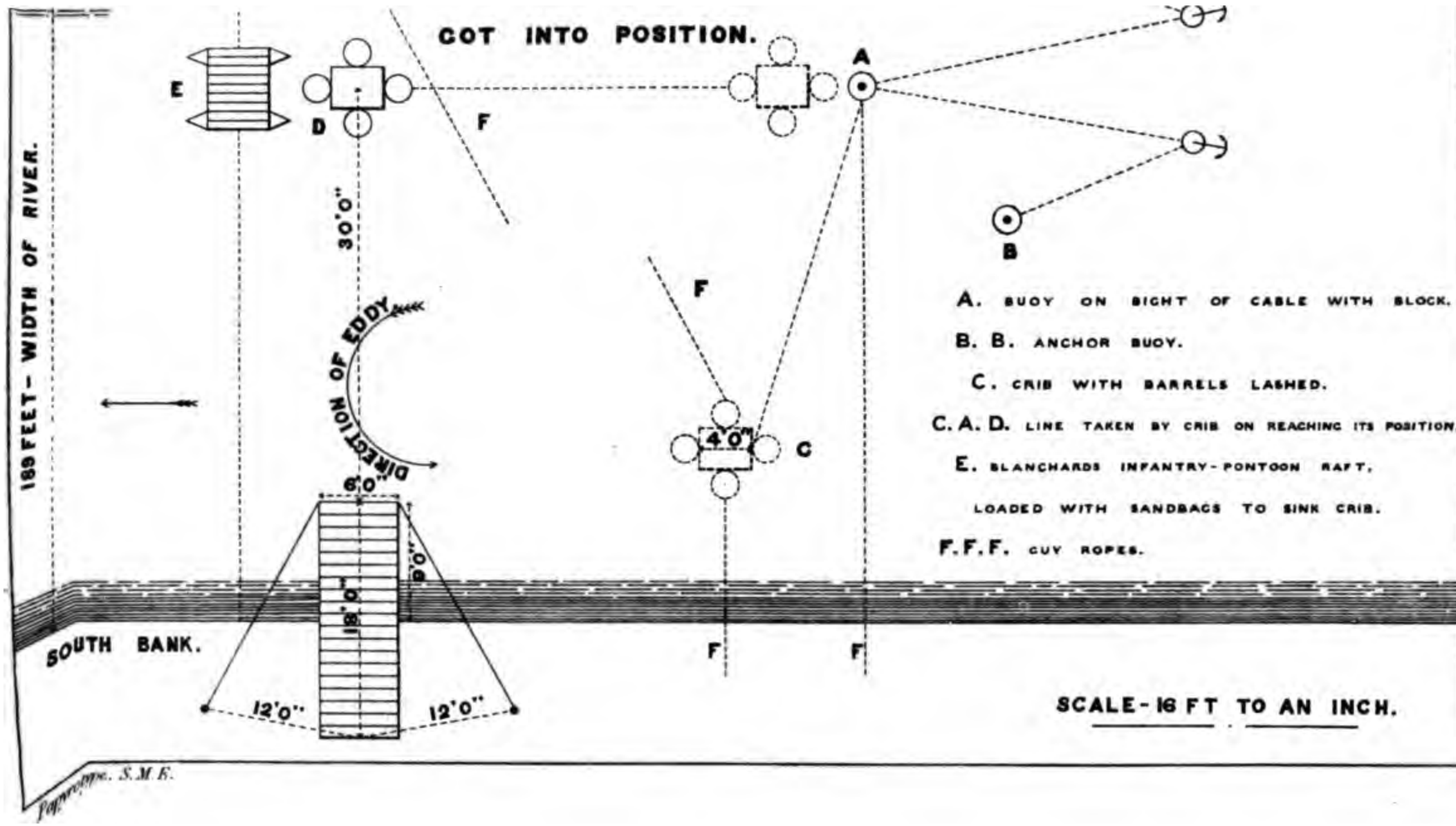
A place for the bridge was definitely selected, and a party put on to cut the bank down in a ramp, a considerable work, as it was 30 feet above the water.

The place selected for the bridge was below a projecting point on the bank, which produced a small eddy; this eddy was selected as a convenient place for launching the cribs.

A stake was fixed in each bank so as to mark the centre line of the bridge, and a take-off was prepared by fixing a trestle in the water as deep as the men could work, or about 5 feet; this take-off, spanned

[1] Models of this and of several other forms of bridge-construction are in the Museum (presented by Colonel Leahy).

[2] The trussed-girders were the development of a girder which had been proposed in 1856 by Major-General Bainbrigge.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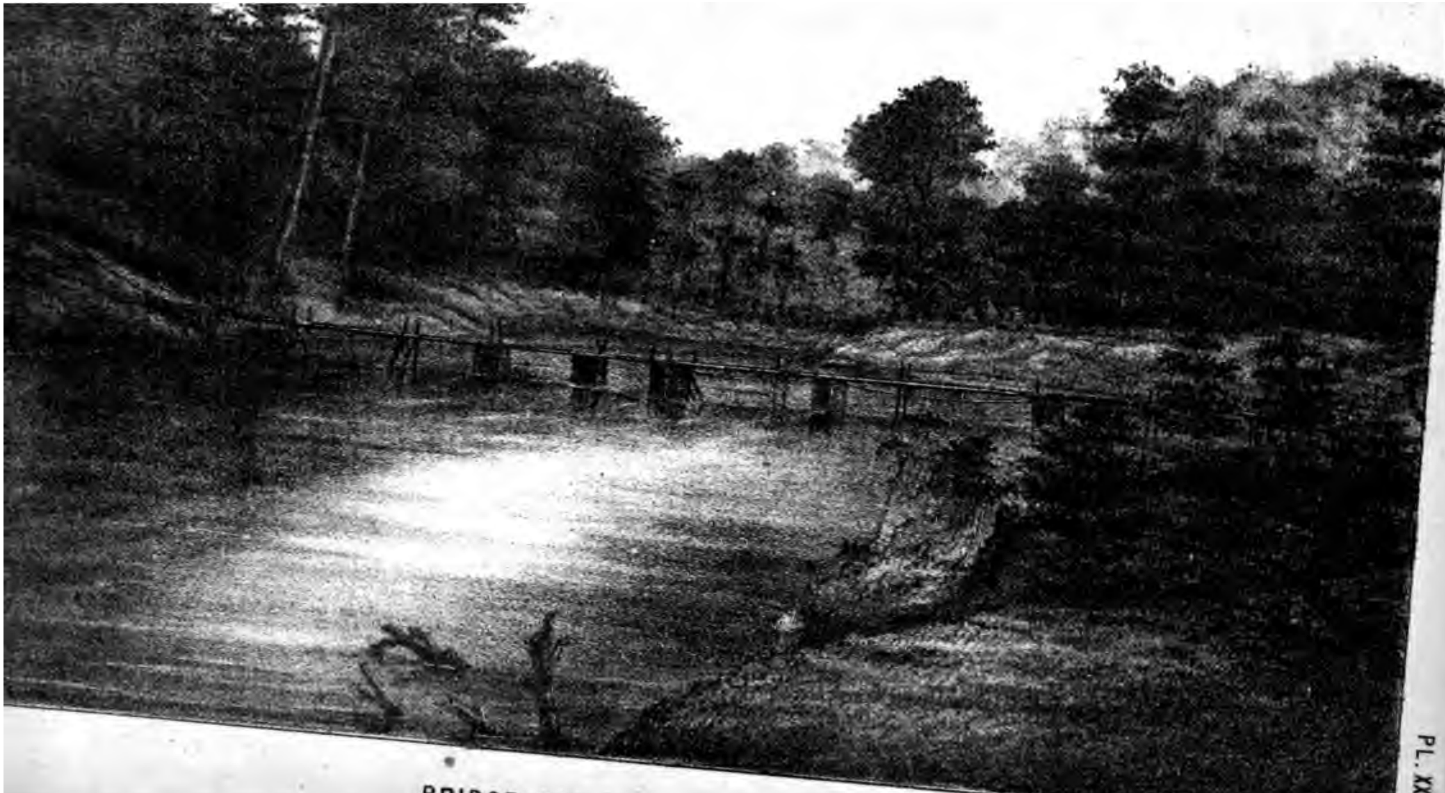
169 FEET – WIDTH OF RIVER.
SOUTH BANK.
A. BUOY ON BIGHT OF CABLE WITH BLOCK.
B. B. ANCHOR BUOY.
C. CRIB WITH BARRELS LASHED.
C. A. D. LINE TAKEN BY CRIB ON REACHING ITS POSITION.
E. BLANCHARDS INFANTRY-PONTOON RAFT,
LOADED WITH SANDBAGS TO SINK CRIB.
F. F. F. GUY ROPES.
SCALE – 16 FT TO AN INCH.
Papyrotype. S.M.E.

PL. XXXII.



BRIDGE ACROSS THE PRAH. 1874

guard and baggage of Russell's regiment moving to the front, passed over it.

The crib that was out of place, showing symptoms of moving, it was relieved by driving strong piles on each side, and the roadway was carried on a cross transom lashed to these piles.

The crib was thus useless, and might have been removed, but it did no harm, and was left in its place. The cribs were all finally lashed with a 3-inch hawser, the roadway secured with telegraph-wire and 10-inch spikes; each crib was further strutted on the down-stream side and an apron of sand-bags and rice-boxes thrown in to prevent any movement; a hand-rail was subsequently added.

On February 11th, 1874, a report was sent to the front to say that the Prah was rising rapidly, and that the bridge was in great danger, but happily on exactly this day twelve months, all anxiety on this score was removed; although the flood rose nearly to the roadway, the bridge was six weeks after, apparently in the same state as when completed, and did not appear to have suffered at all.

The entire number of working hours taken in making the bridge was 61.

The Royal Navy helped greatly in the construction of the bridge, there being only five sappers fit for duty at the Prah.

Military Bridge-Construction.

The conditions to be borne in mind in constructing military bridges, together with the details of the loads due to the passage of troops of various arms, guns, &c., and the formula for calculating the strength and buoyancy of the materials are given fully in our text book on military engineering, from which I have abstracted most of the technical details given in this lecture.

A very convenient epitome of the information required in the field is given in the "Soldier's Pocket Book."

The following points should be borne in mind when constructing military bridges:—

1st. In whatever formation troops are to pass, the bridge should be capable of carrying them when crowded.

2nd. A roadway 8 feet wide in the clear, will admit of the passage of infantry four deep, and of all descriptions of military wagons in one direction, but the width between the hand-rails should not in any case be less than 9 feet; a wider roadway is, if the supports of the bridge admit of it with safety, very desirable, so as to allow Staff Officers or orderlies to pass in a direction contrary to the stream of traffic. In very light bridges, more especially in suspension bridges, the width of the roadway may have to be reduced to the minimum necessary for the wheels of the carriages that have to pass over it, guides being fixed for the wheels. It must be borne in mind that parts of wagons extend beyond the wheel track. The width of a double roadway should not be less than 16 feet. The headway should not be less than 9 feet, and the floor of floating bridge should ordinarily be not less than $2\frac{1}{2}$ feet above the water-line.

Ramps at the end of a bridge if intended for artillery should not

have a slope steeper than one-seventh, but slopes greater than one-tenth are inconvenient, more especially for animals.

Loads on Military Bridges.

The following are the principal loads that can be brought on a bridge by the passage of troops of various kinds, guns, &c.:—

Infantry in marching order, average weight 200 lbs. per man, cause, when crowded, a load of $1\frac{1}{2}$ cwt. per lineal foot of roadway.

Infantry in marching order, in file, crowded, cause a load of about $2\frac{1}{2}$ cwt. per lineal foot of roadway.

Infantry in marching order in fours crowded, cause a load of 5 cwt. per lineal foot of roadway.

Infantry in marching order, when crowded in a disorganised mass, may cause a load of 100 lbs. per *square* foot of standing room, and unarmed men, average weight 160 lbs. per man, may, when crowded in a disorganised mass, cause a load of 133 lbs. per *square* foot of standing room; this, in a bridge 8 feet wide, would be about 9 cwt. per foot lineal of roadway.

Cavalry in marching order, in file, each man and horse together weighing about 1,400 lbs., and occupying 12 feet lineal of bridge, cause a load of about 1 cwt. per lineal foot of roadway.

Cavalry in marching order, in file, crowded, cause a load of less than $1\frac{3}{4}$ cwt. per lineal foot of roadway.

Cavalry in marching order, in half sections, crowded, cause a load of nearly $3\frac{1}{2}$ cwt. per lineal foot of roadway.

The following table gives the weight of field guns, &c., fully loaded for travelling:—

Description of gun, &c.	Weight upon fore and hind wheels respectively.			
	Fore, or limber.		Hind, or gun.	
	cwt.	qrs.	cwt.	qrs.
16-pr. M.L.R. gun (iron)	16	2	25	2
9-pr. „ „ „ of 8 cwt.	12	0	19	2
16-pr. ammunition wagon	17	0	23	3
Pontoon wagon	15	0	24	0
Wire wagon	15	3	22	3
General Service wagon with springs { heavy	28	1	34	4
General Service wagon with springs { light	18	3	26	3
Small arm ammunition cart	—		19	0

For calculations of strength and buoyancy, the following classification of bridges may be found convenient.

1. Foot bridges for infantry in single file; breadth of roadway up to 3 feet; maximum load per lineal foot of roadway about $1\frac{1}{4}$ cwt.

2. Infantry bridges for infantry marching two abreast; these bridges would usually be available for cavalry in single file, leading their horses and light guns passed over by hand. Breadth of roadway, 6 feet; load per lineal foot 2½ cwt.

3. Advanced bridge equipments available for a field force of infantry in fours, cavalry in half sections and field artillery; breadth of roadway, not less than 8 feet. Load about 5 cwt. per foot run.

4. Heavy bridges adapted to the passage of siege artillery. These usually require to have special arrangements made for strengthening the roadway and supports.

It should be noted that the greatest weight which the pier of a bridge is likely to sustain during the march of an Army, is caused by crowded infantry, and that the weight of crowded cavalry may be greater than that of artillery. It is necessary to bear this in mind—because during the passage of the Elbe at Priestnitz, in 1813, the Officer in command of the cavalry, thinking that because the artillery had passed there was no reason to question the security of the bridge for cavalry, let his files close up, and afterwards trot, the result was, that the bridge broke down.

Sites for Bridges.

In choosing a site for a bridge across a river, the chief points to be recollected are:—

1st. The site should be as near as possible to the main communications.

2nd. The position most easily defended is a re-entering bend, where the bridge may be secure from fire, and the ground in front exposed to a cross fire from the near bank.

3rd. The bridge should, if possible, start under cover of a commanding bank, woods, or undulations, while the opposite bank should be open.

4th. Banks or marshes which make the approaches to the bridge difficult, or portions of the stream with very strong currents or shoal-water, should be avoided.

5th. In tidal rivers, banks steeper than ⅓th, or beds likely to injure the piers when grounded, should be avoided.

6th. In attempting the passage of a river in face of an enemy, every practicable ruse should be devised to conceal the point at which the passage is to be made.

7th. The first operation should be undertaken with detached means, such as row-boats, rafts, and flying bridges prepared beforehand, and concealed until the passage is to be attempted.

A *flying bridge* is one in which the action of the current is made to move a boat or a raft across the stream, by acting obliquely against its side.

I have already stated that military bridges are of two classes, viz.:—

I. Floating, } bridges.
II. Fixed }

These may again be considered under two heads:—

1st. Those formed of bridge-equipments prepared to accompany an army.

2nd. Those improvised out of such material as can be locally procured.

In designing a permanent bridge, solidity, durability, and economy are the chief points the engineer has to consider; but a condition under which military bridges have in nearly all cases to be formed, is *rapidity of construction*, and consequently the necessity for this has to be kept in view in all typical forms of bridges proposed for the equipment of an army, or for the instruction and practice of troops.

Another condition which, though not common to all cases, is in many even of more importance than the first, is *portability*.

Subject to these conditions, there is little difference between the kind of technical knowledge required in a military as compared with a civilian bridge-constructor; but it will be manifest that experience in the direction of skilled labour, and practice in turning local resources to the best account, are desirable, if not necessary, qualifications in a military bridge-constructor.

Improvised Field Bridges.

The types of improvised bridges constructed in carrying out the courses of bridging laid down for our troops are of the two kinds already mentioned—

I. Floating bridges.

II. Bridges with fixed supports.

The fixed bridges are of four kinds, namely:—

1st. Trestle and pile bridges, applicable to rivers or gaps where the bottom is available for supports.

2nd. Frame bridges used for clear spans up to 60 or 70 feet.

3rd. Tension bridges used for clear spans up to 100 feet.

4th. Suspension bridges, which may be used for still larger spans.

For improvised fixed bridges, timber (often green and in the rough) is the material most frequently available.

The ordinary fastenings are rope lashings, wooden trenails, and iron bolts and nuts, nails, spikes, and dogs.

For instructional purposes, round spars and rope lashings, materials which admit of being used repeatedly, are generally employed, hence the term "spar-bridging;" but it should be clearly understood that the principles which regulate the construction of spar-bridges equally apply to structures in which timber of any other form, and other kinds of fastenings than rope are used. Iron fastenings are, of course, better suited than rope for semi-permanent bridges, and for those made of material not required for re-use.

Before troops are employed at bridging, they should be thoroughly instructed in the various knots and splices used in lashing spars together. The knots and lashings, a knowledge of which is essential for

spar-bridging, are few in number, they are easily learnt, and if not practised, are easily forgotten.[1]

Trestle Bridges.

Trestles are most useful in establishing communications across shallow rivers, having sound and hard beds, and which are not subject to sudden floods; for crossing ravines (up to 30 or 40 feet deep), where the bottom is available for support; and for crossing roads in use.

They can be readily constructed of any kind of timber, and are easily placed in shallow water, but are not so suitable for deep muddy rivers. Light rails and sleepers have been used for making trestles.

Single frame trestles may be used in streams 6 feet deep, and running with a velocity of 5 feet per second (equal to 3½ miles an hour), or in deeper streams if the velocity of the current be less. They are suitable for any kind of tolerably firm bottom.

Tripod trestles may be used in water up to 6 feet deep, with a velocity of 5 feet per second, and in streams with muddy beds. Their great advantage is, that if the water rise, or one tripod sink into the mud more than the other, the level of the roadway can be readily adjusted.

When timber is plentiful, it has sometimes been found best to build solid piers of crib work, weighted inside with stones, &c., instead of using trestles. The piers of the bridge across the Prah were of this nature.

Pile Bridges.

When the legs of the trestles or supports are driven into the ground, they are termed pile bridges.

The bridge across the Ordah was of this type.

It was made under the following conditions:—

The river Ordah, about 10 miles from Coomassie, was reached by the European force on the afternoon of the 3rd February.

The river was 80 feet wide and 3 to 4 feet deep, and the construction of the bridge was at once commenced, and with a short rest, continued throughout the night and was completed at 5 A.M. No material or fastenings of any kind except what grew on the banks were available; the only tools were axes.

On the return march on February 6th, the heavy rains had swollen the river, which rose 18 inches above the roadway. The bridge was damaged, but its reconstruction would have taken some hours, which could not be spared for the purpose. The force, except the rear-guard, including all baggage and stores, were, however, able to get over the bridge.

As night was coming on and the river was rising rapidly, the rear-guard forded the stream, the water being up to the men's shoulders, natives who could swim, taking over the arms and clothes.

[1] For technical details of Military Bridge Construction, see vol. i (Part III) Instruction in Military Engineering." Edition, 1875.

Frame Bridges.

Frame bridges are used to provide intermediate points of support where piers resting on the ground or floating piers are not available. The length of the intervals between the supports depends on the strength of the available road-bearers, while the width of the opening and the depth of the footings below the surface, decide the form of the bridge.

The forms commonly used are:—*Single* and *double lock* bridges, which provide one and two points of support respectively, and *sling* bridges, which provide a larger number.

Types of these bridges are given in Plates XXXIII. to XXXVII.

Single-Lock Bridges.

The single-lock bridge (formerly called single lever) is not suitable for greater spans than about 30 feet; it is composed of two frames locking into each other, as shown in Plate XXXIII.; these frames should not slope more than two-sevenths. The bridge can be erected by a party of two Non-commissioned Officers and 20 men, half on each side of the stream or chasm, in two hours, provided proper stores are available and in position on either side of the stream.

Double-Lock Bridge.

The double-lock bridge (formerly called double lever) is suitable for spans of 40 feet, and consists of two frames locking into a connecting frame of two or more distance-pieces with cross transoms as shown in Plate XXXIV.; the opening is thus divided into three spaces, and the span of the road-bearers is about 14 feet. The bridge can be constructed by a party of three Non-commissioned Officers and from 24 to 48 men, and be completed in three to four hours.

Single Sling Bridge.

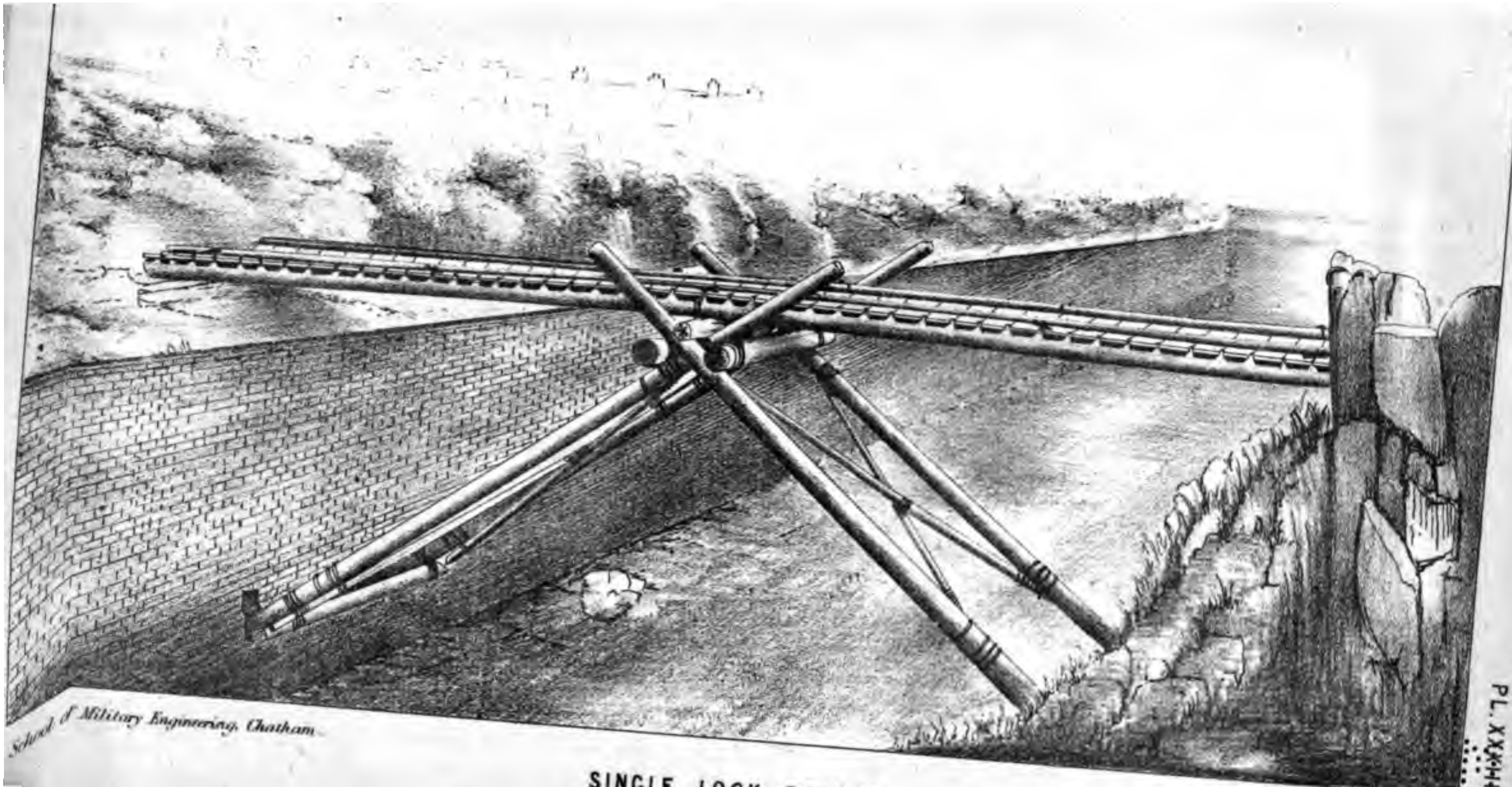
The single sling bridge (formerly called the single truss) can be used for spans up to 50 feet; it consists of two frames locking into each other in the same manner as in the single-lock bridge, and provides three points of support, viz., one on each frame (a) and (b), and a third (c) suspended by slings from the heads of the frames (Plate XXXV). The bridge requires a party of three Non-commissioned Officers and from 30 to 48 men. The operation of getting the frames into position will require about four hours, and the roadway can be laid and bridge completed in about six hours.

For either of the foregoing bridges extra time should be allowed if the footings have to be cut in masonry or brickwork, as would be necessary in restoring a broken arch, or if trestles had to be formed as at (d) Plate XXXV.

Stiffened Single Sling Bridge.

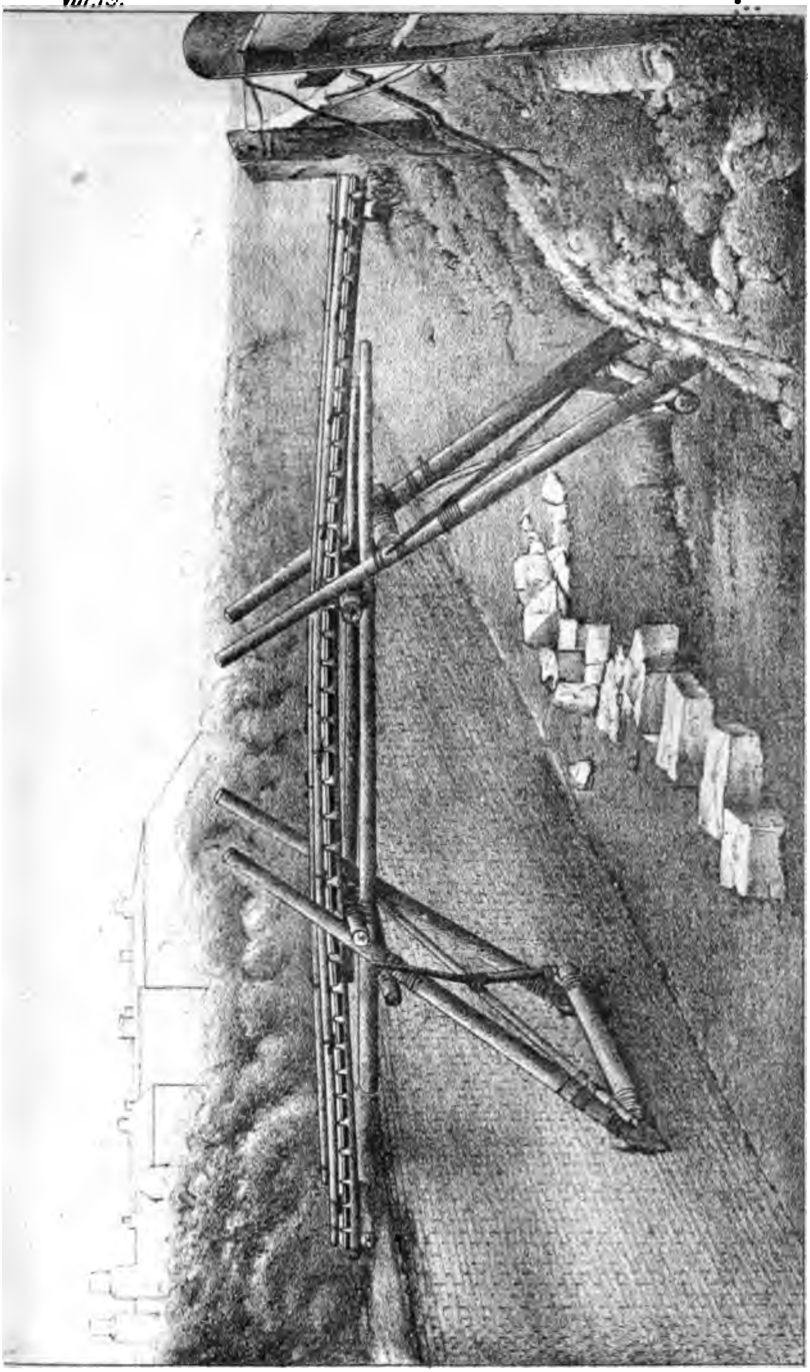
The single sling bridge may be adapted to spans up to 60 feet by the arrangement shown in Plate XXXVI.

PL. XXXIII.



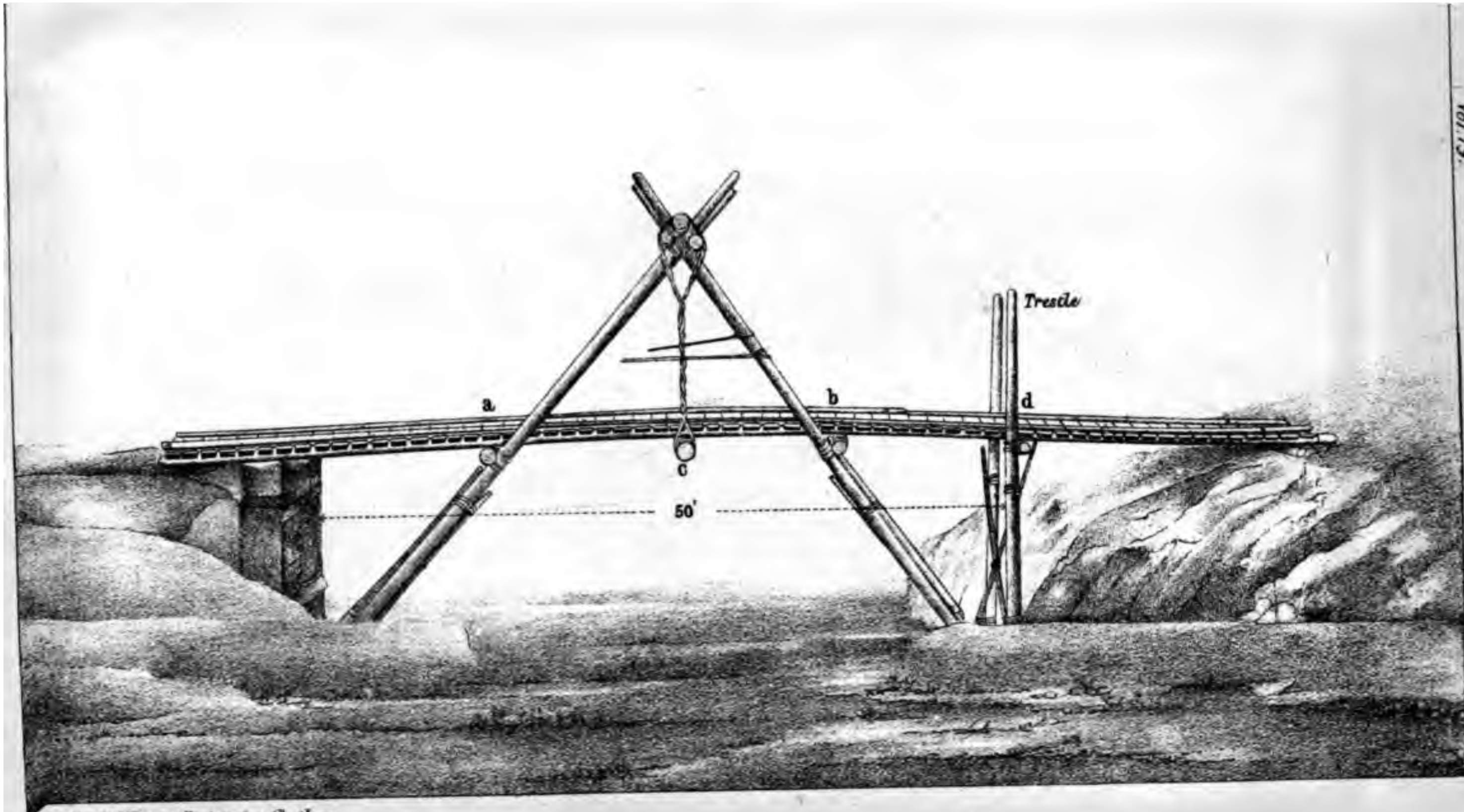
School of Military Engineering, Chatham.

SINGLE LOCK BRIDGE.



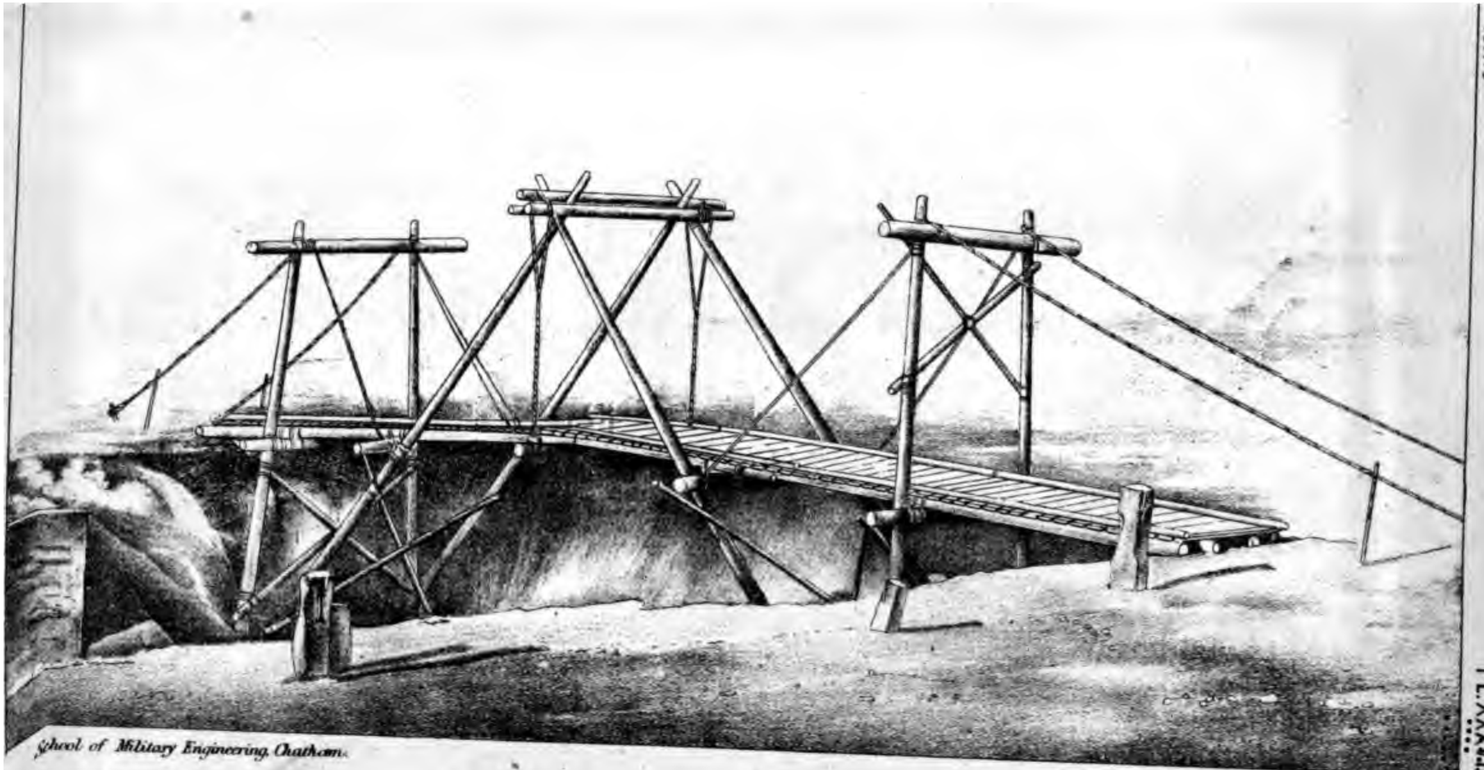
DOUBLE LOCK BRIDGE.

School of Military Engineering, Chatham.

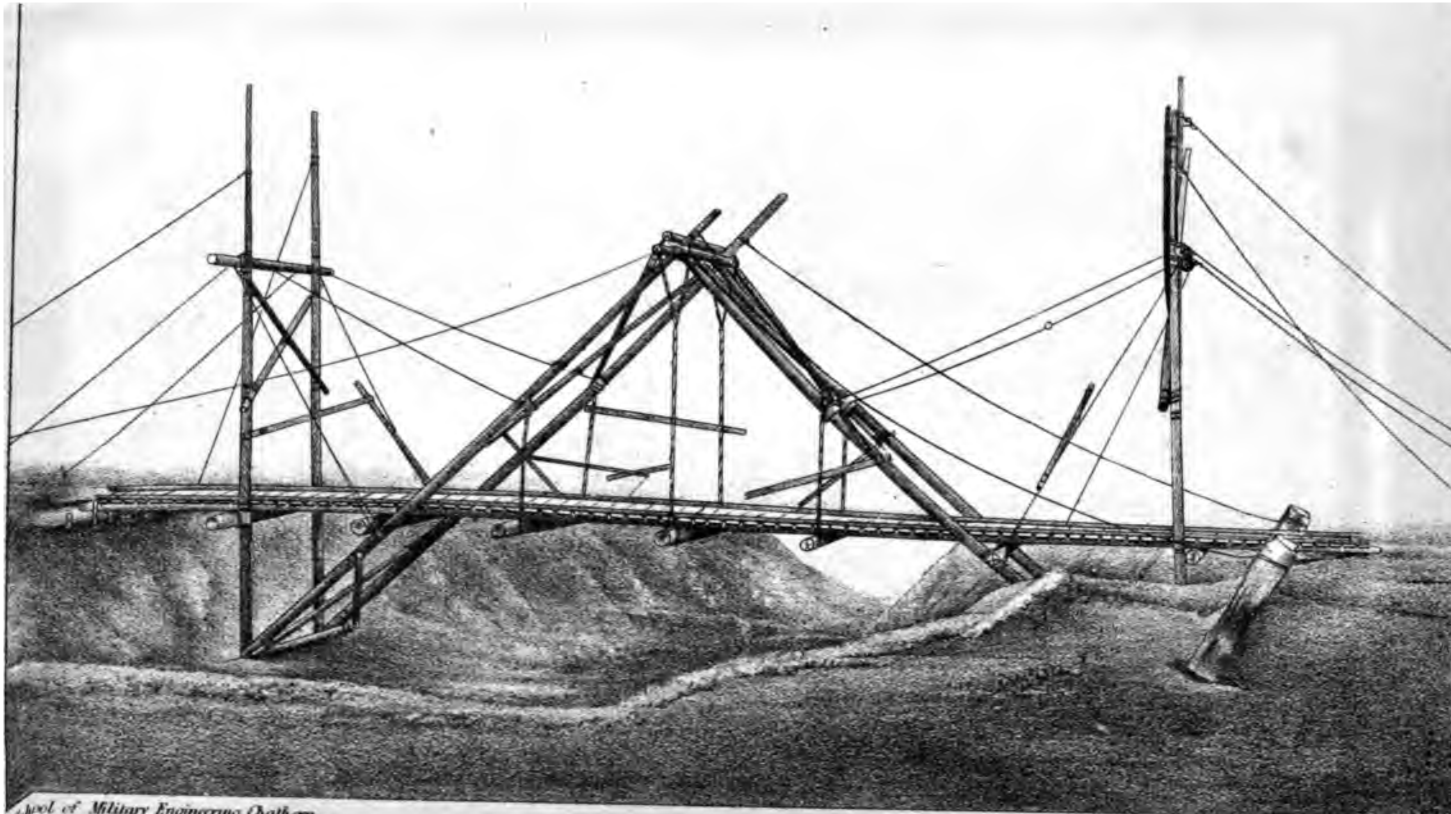


School of Military Engineering, Chatham.

SINGLE SLING BRIDGE.

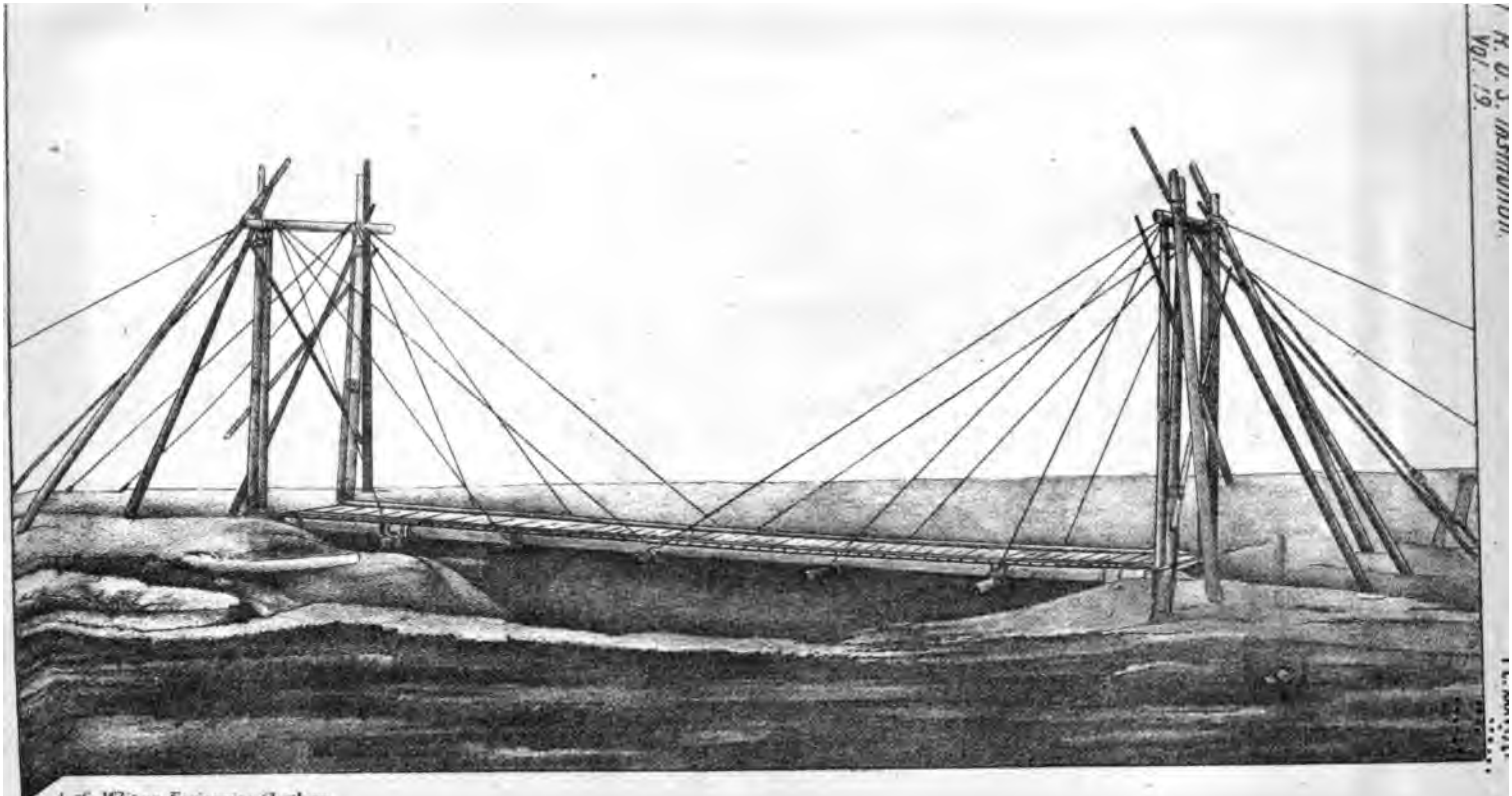


STIFFENED SINGLE SLING BRIDGE



School of Military Engineering, Chatham.

TREBLE SLING BRIDGE.



School of Military Engineering, Chatham.

TENSION BRIDGE.

PL. XXXIX

STRUTTED TENSION BRIDGE.

A bridge of this form (span between points of support 60 feet) was constructed so as to carry a 40-pounder B.L.R. gun (63 cwt. on hind wheels), and over 40 men $5\frac{3}{4}$ hours after it was commenced, the standards being yard-arms, two of them only 5 inches at the butts, the ties of hemp—(3 in.)—rope.[1]

Treble Sling Bridge.

The treble sling bridge stiffened by ties as shown in Plate XXXVII., is one of the strongest that can be made with spars and lashings, and may be used for spans up to 70 feet. This bridge only differs from the last in having each standard tied at two points instead of one, which allows the span to be divided into six parts.

A party of three Non-commissioned Officers and 36 to 48 men should make this bridge in six to ten hours if the materials were all at hand.

Tension Bridges.

When the span exceeds 60 or 70 feet, or when the standards required for frame bridges cannot be procured, tension bridges (examples of which are given in Plates XXXVIII. and XXXIX.), may be found suitable.

The advantages of these bridges are:—

1st. They are suitable for larger spans.

2nd. The ties are more easily transported than timber.

3rd. The roadway is as rigid as that of a spar bridge.

They take, however, longer to make than trestle bridges, and except with very strong materials, are only suitable for narrow roadways arranged to suit the track of the carriages which have to pass.

The strutted tension bridge (Plate XXXIX.) was constructed across a clear span of 100 feet, but is equally suitable for smaller spans.

Suspension Bridges.

In suspension bridging there are three convenient ways of using the suspension cables as supports for the roadway.

The first and most usual method is to hang the roadway below the cable.

The second is to lay the roadway partly on the cables and partly on baulks.

The third is to support a horizontal roadway on trestles carried by the cable.

The first provides a road fit for all kinds of traffic, but requires more materials than the others.

The second plan is the simplest, and requires least materials; it answers for troops and light guns.

The third provides a very stiff bridge, and saves having high piers, but is more influenced by wind, and is unfit for crossing water with banks lower than the heights of the trestles.

[1] This bridge was constructed by a class of Officers of the Guards, cavalry, and line, and some Royal Engineer recruits, under the direction of Captain T. Fraser, R.E. (Assistant Instructor in Field Fortification), by whom many of the details of the bridges described, have been worked out.

The site for a suspension bridge should be chosen with banks of the same height, and of sound rock or clay.

The best materials for cables are iron chains, steel or iron-wire ropes; hemp ropes, iron gabion bands, sail cloth, thongs of hide, and ropes of creepers or grass, or even small baulks pinned, or boards nailed together, are sometimes employed.

The roadway of a suspension bridge ought not as a rule to be wider than is necessary to allow of the passage of the vehicles it is to carry.

In India, suspension bridges for foot passengers are made of one or two cables, with hand-rails of rope or bamboo.

Floating Bridges.

Floating bridges afford a continuous roadway, supported on *piers* of boats, casks, or rafts. The piers are connected by beams, usually called *baulks*, on which a roadway of planks, usually called *chesses*, are laid.

Pontoon is the name given to a portable floating pier specially prepared for military bridges.

In floating bridges, each pier must have enough available buoyancy to support the heaviest load that can come over it. The piers should be at as wide intervals as their buoyancy and the strength of the baulks will permit.

The supports of a floating bridge should be at least twice as long as the width of the roadway, unless the buoyancy is much in excess of that required.

If it be not possible to make the bridge strong or wide enough to carry the different arms when crowded, notices should be put up at the bridge, stating what loads may safely cross.

Straw laid on the planks of a bridge deadens the noise for horses and prevents slipping.

In cases where there is a large tidal variation, the arrangement of bridge-ends, to be at all times available, is a work that requires much time, materials, and labour, and may be impracticable for hasty operations.

Cuts are sometimes wanted in floating bridges to allow traffic to pass, or to permit large floating objects, such as trees or ice, to be towed or guided through the bridge.

Boats or coasting vessels, &c., being frequently required in military operations for making bridges, it is necessary to be able to determine their flotation.

On rivers, boats are often of a nearly uniform section; this section multiplied by their length will give the cubic contents, and the cubic contents in feet, multiplied by $62\frac{1}{2}$, will give the weight of water displaced in lbs., and the consequent buoyancy.

With small boats, the easiest way is to load them with unarmed men to such a depth as is considered safe for bridging, then multiply the number of men by 160, and the result is the available buoyancy in lbs.

A rough rule for the proper interval between boats in bridge is to divide the number of men they safely hold by 4, and the result is the number of feet the boats may be apart from centre to centre. Thus, boats holding 60 men might be at 15 feet central intervals.

A simple practical rule for finding the buoyancy of a cask is to multiply the number of gallons it contains by 10, which gives a result in lbs. a little less than the actual buoyancy.

The buoyancy of timber, &c., for rafts will be found by calculating its cubic contents and deducting the weight of the material from that of the water displaced.

Anchors are required to counteract the effect of the current or wind on floating objects; the nature of holding ground, and the strain on the cables, regulate their size. To ensure holding, the length of the cables should be 10 times the depth of the stream, and in no case less than 30 yards. When the length is less than three times the depth, the anchors seldom hold.

An improvised anchor may be made of pickaxes lashed together, of bent iron bars, or of wicker cases filled with stones.

Portable Bridge Equipments.

The portable bridge-equipment, which forms part of the *matériel* requisite for evèry field force, usually comprises two forms of bridge-construction capable of being used either separately or in combination, viz., pontoon bridges and trestle bridges; the first forming a floating and the second a fixed bridge.

Complete bridges can only be constructed of pontoons alone across channels, when there is water at either bank, sufficient at all times to float the pontoons, a condition not usually obtainable in waters subject to rise and fall of tide, or to sudden changes of depth, due to floods from falls of rain, &c.

It follows, therefore, that even for crossing rivers, the bridge-equipment can rarely be confined to pontoons, and there are, of course, cases where the military communications may have to be rapidly completed over gaps where a pontoon cannot be used at all. An equipment of fixed supports (usually trestles) is in such a case a necessity.

As the pontoon and trestle equipment, which accompany the advance of an army, are usually required to be moved along with the divisions to which they are attached, they have frequently to be replaced by other non-portable bridges made out of such material as can be most conveniently procured.

In such cases, rapidity of construction, with a view to set free the portable equipment, and fertility of resource in turning to the best account the materials at hand, should mark the military bridge-constructor.

To give effect successfully to these requirements, the directing officer should be thoroughly trained to bridge-construction. He should endeavour, by a proper distribution of men and material, rapidly to construct his bridge of the required strength; questions of appearance, economy of material, and permanency being of secondary consideration.

In the Journal of this Institution,[1] will be found carefully prepared papers, giving detailed particulars of the pontoons and trestles used in the bridge-equipments of the chief continental armies, and those which were in use in the British Service up to the year 1870. In these papers, the merits and demerits of the pontoons described, are minutely entered into. The subject was then of considerable interest, as a change in the nature of our own bridge-equipment was deemed necessary, and there was naturally much discussion as to what the new pattern should be.

After much consideration and practical trial, the pontoon (Plate XL.) was adopted for the British Service.

Attention is also directed to the German pontoon (Plate XLI.), which has, of all foreign models, been that most largely and successfully used in late wars.

Pontoons.

A pontoon should fulfil the following conditions:—

1. It should be capable of sustaining the greatest load liable to come over it while in bridge.

2. It should be as portable and light as consistent with the first condition, and with the capability of standing the rough usage to which it would be subject on active service.

3. The pontoon, with its corresponding superstructure, should be of such a form as to admit convenient stowage in wagons, and of being easily converted into a bridge, and of being rapidly moved with the advance of an army.

4. It should be of a form and material that admit of a ready examination and of being easily repaired, and it should not be liable to damage or leakage from alternate exposure to wet and heat.

5. Wagon loads should be complete in themselves, and the parts of the equipment should be interchangeable.

6. The pontoon should be capable of being used as a boat.

Austria.

The Austrian pontoon and trestle equipment is fully described by Colonel Lovell in vol. ix, pages 42—46 of the Journal of this Institution.

The pontoons are formed in sections, and in making bridges, two, three, or four of these sections are used according to the degree of buoyancy required in the supports. Supports made of two sections are supposed to meet ordinary requirements.

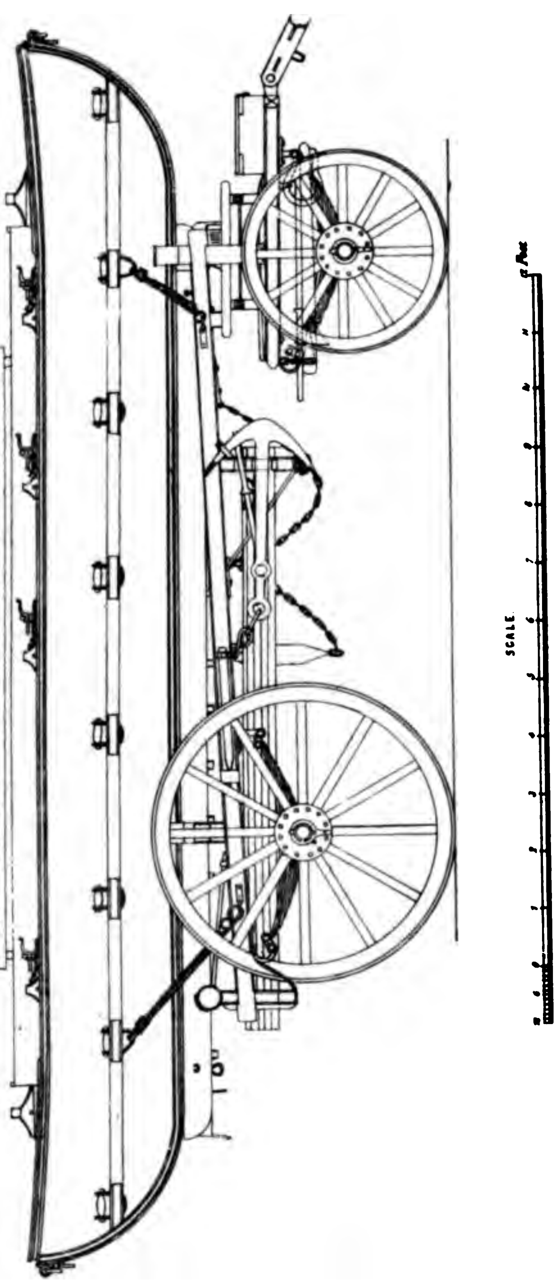
Single sections may be used for narrow infantry foot bridges. Owing to the size of the pontoons, and the distance at which they are placed apart, some of the superstructure of the equipment is clumsy and not easily handled.

The trestles used in the Austrian pontoon equipment (see Plate IX., page 44, vol. ix), are two-legged, usually called "Birago trestles" (after General Birago, by whom the Austrian equipment was devised), and are of the kind most largely used in the bridge-equipments pre-

[1] Vol. iv., pp. 237, et seq; and vol. ix., pp. 29, et seq.

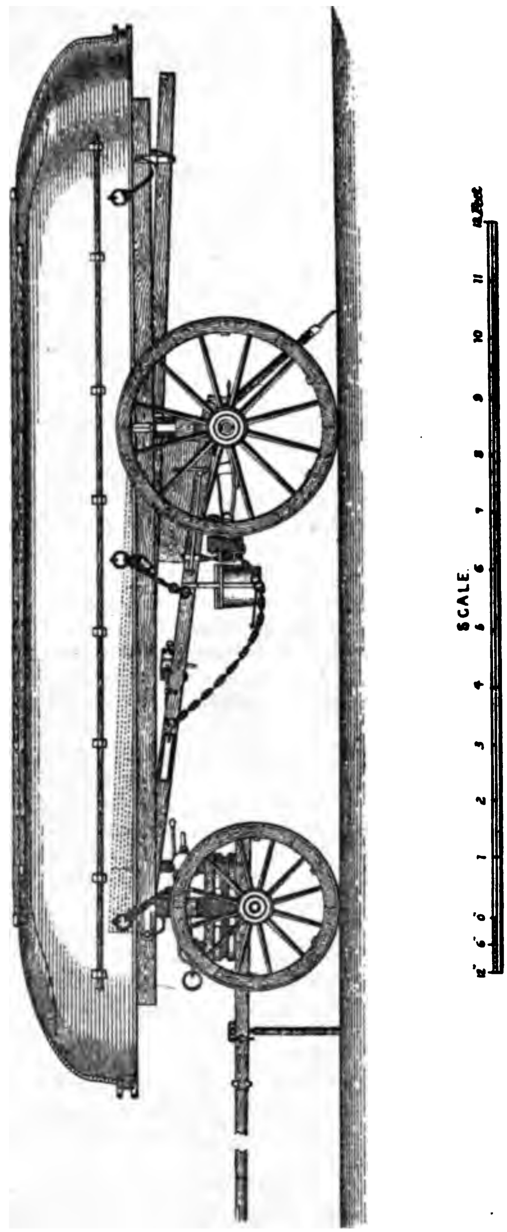
PL. XL

BRITISH PONTOON LOADED ON WAGON.

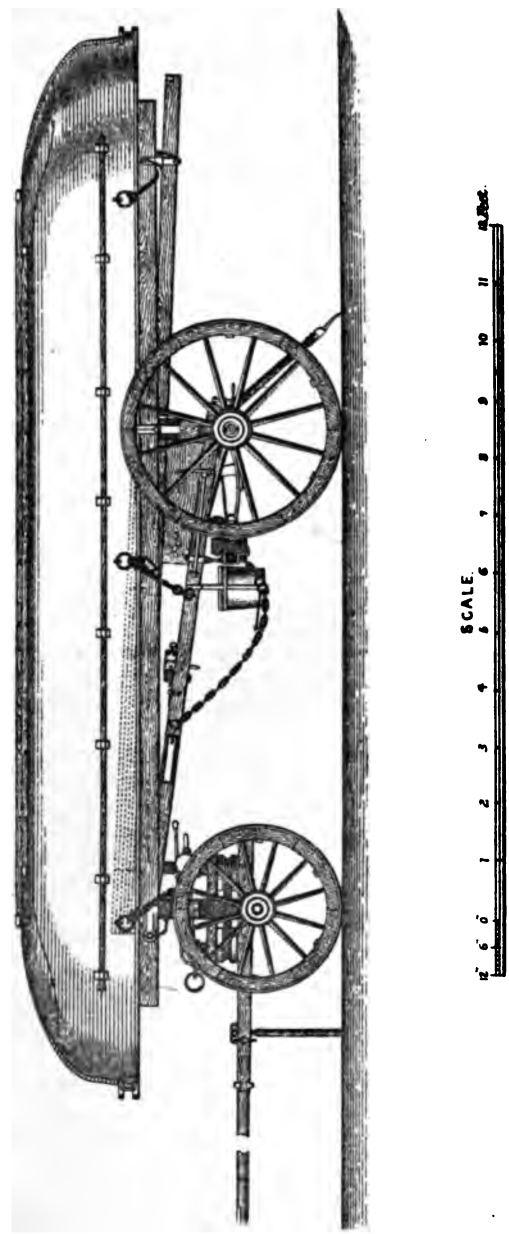


Papworth. S.M.E.

GERMAN PONTOON LOADED ON WAGON.



GERMAN PONTOON LOADED ON WAGON.



pared to accompany Army Corps. They are easy of transport, and when the bed of the river is fairly solid, and the depth and current of the water not great, they make a good bridge for field troops. Their stability, not at any time as great as could be desired, depends on the cleated baulks which connect them with the shore.

Each trestle is provided with three sets of legs to suit various depths of water.

Their great disadvantage is, that if, on account of alteration in the depth of water due to rise and fall of tide, or other causes, it becomes necessary to alter the level of the bridge in deep water, this cannot always be done without stopping all traffic, and without considerable subsequent delay in re-adjusting the heights of the cross-pieces (transoms) which support the roadway.

A section of the bridge-train consists of 14 wagons, each carrying part of a pontoon, and provides supports and superstructure for 168 feet of bridge. There are 40 such sections = 6,720 feet = 2,900 yards of bridge, and 8 more in reserve.

During the year 1873, pontooning operations took place near Linz, at which point the River Danube is about 280 yards wide, and the current very rapid, in some cases as much as five miles an hour.

The number of men employed to construct a bridge varied, and amounted to from 300 to 400 men, including Non-commissioned Officers. The time occupied was from 3 to $1\frac{1}{2}$ hours, the minimum time being when the work was done in the presence of the Emperor.

Openings were made in the bridge to admit of the passage of steamers, &c., the average time taken to make the opening was about 10 minutes, and to close it 14 minutes.

By night the bridge was put together in $2\frac{1}{2}$ hours, about one-half the length having been formed by day and brought into position by night.

Large numbers of troops were, during the operations, ferried across the river in pontoons.

Belgium.

The Belgians have a pontoon-train-equipment for about 260 yards of bridge.

The pontoon and trestle-equipment are very fully described by Colonel Lovell, pages 49, 50, vol. ix.

The trestles are three-legged, and of a construction which admits of the adjustment of the legs to suit uneven ground. Their great advantages are, stability and facility for altering the level of the bridge during rise and fall of tide. They are more difficult to place in deep water than two-legged trestles, but when placed, they are safer.

The shape of the pontoons has been worked out with great care, and they possess, in a high degree, many of the elements of a good pontoon.

Their weight, 1,200 lbs., is, however, greater than appears admissible for a train which is to keep up when necessary with the advance of an Army.

France.

The French Bridge-Equipment, as approved in 1853, and still used, comprises 4 divisions and 1 reserve. The equipment is composed of open wooden boat pontoons, light boats, and trestles (2 legged). The proportion in each division of pontoon-train consists of 8 pontoons, 2 trestles and 1 light boat.

This is sufficient for 58 yards of bridge without using the trestles, and 70 yards using the trestles.

The complete equipage is sufficient for about 215 yards of bridge without using trestles, and 265 yards if trestles are used.

The French pontoon train was largely used in the campaign of 1859; and after the experience of that campaign, it was stated that the regulation bridge-equipment, while well adapted as a reserve for the passage of large rivers, did not possess the mobility necessary to enable it to follow the movements of the Army divisions, or to render all the services expected of it in a country intersected by numerous watercourses of medium size.

A lighter equipment has been under trial, but I learn that it has not yet been adopted.

Holland.

The Dutch pontoon train consists of 2 companies and a depôt. One company is organized to accompany a field force, and consists of 3 officers, 21 non-commissioned officers, and 175 men.

The pontoon is an open flat-bottomed wooden boat, with flat sloping ends. Length, 26 feet. Weight about 1,250 lbs.

It is, like the French pontoon, too heavy to be carried on the same wagon with its superstructure, and the introduction of an improved pattern is contemplated.

The number of pontoons (30) is sufficient for 220 yards of bridge.

The trestles used are of the Belgian pattern. Eight are carried, sufficient for 28 yards of bridge.

Total bridge train, nearly 250 yards.

Pontooning operations take place annually at Dordrecht, where the river is about 150 yards wide, the rise and fall of tide being about $4\frac{1}{2}$ feet.

The Dutch Army being a militia force, the time allowed for training their pontooneers is very short.

Russia.

The Russian bridge-trains are composed of half a battalion (two companies) of pontooneers to each Army Corps. Each company consists of 200 non-commissioned officers and men including 60 drivers. Each half battalion has 26 iron pontoons in two compartments (carried on 52 waggons) and 12 trestles, and the equipment is sufficient to form a bridge 260 yards in length.

The Russian pontoon is in form and size very similar to the Austrian, and the superstructure is of the same kind.

The trestles also resemble the Austrian bridge pattern.

Germany.

The new pattern German pontoons are of iron; an old pattern of the same shape is of wood, and is now used for reserve equipments. The pontoon has similar boat-shaped ends, is not decked, and the material not being buoyant, it is liable to sink in case of accidental damage. (Plate XLI.)

Its weight is about 950 lbs., and its available buoyancy is from 9,000 lbs. to 10,000 lbs.

Used singly, the pontoons do not make safe boats for a number of men, but whether used as boats, or in bridge, they offer, from their shape, less resistance to wind and current than pontoons with square ends.

The pontoons, as well as the superstructure, are of simple form, they can be placed in bridge at any desired interval apart, and are readily adapted to the varied conditions under which a portable bridge-equipment may have to be used.

Since the last war, the arrangements for the manning and equipment of the German Pontoon Corps have been modified, and the system previously in force of having only the company for each army corps trained as pontooneers, has been abandoned.

Every company of the engineer force liable to take the field, is now trained to undertake bridging operations, and in place of heavy and light bridge-trains, all bridge-trains are alike, and capable of being used together.

Under the Regulations, date 1874, now in force, each army division has a divisional bridge-equipment, composed of 6 pontoons and 4 trestles, sufficient for 43 yards of bridge, and each army corps has in addition a corps equipment of 24 pontoons and 2 trestles sufficient for 146 yards of bridge. Total for each army corps, 232 yards of bridge.

This equipment is always in charge of the officers and companies told off to move with it on service in the field, and they use it (when required) for their annual practice, and keep it in repair.

In addition to this equipment which appertains to the army corps, there is a certain small amount of bridge material allowed for instructional practice; there are also, in charge of the engineer troops quartered in the fortresses on important rivers, such as the Rhine and Elbe, reserve equipments for service in those rivers, the amount being what is considered sufficient for any special bridge likely to be required.

It will thus be seen that, as the result of their experience during the late war, the Germans have increased their cadres of bridge-constructors, and simplified their equipment with a view to obtaining greater bridging resources.

In addition to the regular bridging-exercises of the German engineer troops, whose head-quarters are always fixed at some fortress

on a river so that they may have constant practice in bridge-construction, pontooning operations on a large scale take place periodically on one of their more important rivers.

Last year these operations took place on the Southern Elbe at Harburg, and a short account of them may be of some interest.

The operations were carried out between July 20th and August 15th, 1874, in accordance with a programme which had been prepared some months beforehand, and a sum of money was placed at the disposal of the Directing Officer (Colonel Crüger), to defray all attendant expenses.

The troops taking part in them were 2 companies of pioneers from each of 4 Army Corps (Guards, 4th, 9th, 10th), and one company from the 3rd Army Corps. Total 27 officers and about 800 non-commissioned officers and men.

A Captain or senior Lieutenant from every pioneer battalion not represented by companies, was also ordered to attend the operations.

The Elbe, at the point selected for the practice, was from 370 to 400 yards wide.

The material used in making the bridges was the bridge-equipment of the 3rd, 4th, and 9th Army Corps, the Elbe Reserve, and the instructional *matériel* of the 4th and 9th Pioneer battalions.

This was sufficient to enable two bridges, total length about 750 yards, to be constructed daily at two separate bridging grounds about 1,200 yards apart.

The exercises were carried out for five days in each week, and various modes of constructing bridges were practised, both by day and night.

On each occasion, bridges complete in all respects were formed, and cuts for the passage of boats and barges were opened and closed.

The work was essentially practical and instructive.

Among the more noticeable operations were:—

The construction of a bridge 370 yards long, in a very dark night in less than two hours. The work was carried out so quietly that noise could not be heard a few hundred yards off.

On another occasion, the programme was to convey the materials in rafts some three miles down the river, and to form a bridge at a site indicated.

The spot selected was near Sandau.

The river here has a breadth of 400 yards, and a smaller arm had also to be bridged over in order to complete the communication, its breadth being 140 yards.

It was ordered that the material should be formed into rafts of four pontoons, and be brought up on the morning of the 6th, so as to reach the bridging ground at 7 A.M. In order to do this, some of the men had to leave their cantonments soon after 3 A.M. The rafts left the bridging ground at Harburg at 5 A.M., and at the appointed time, the bridge was commenced by placing some trestles.

During the forenoon the wind rose and blew a gale and the tide rose abnormally. It was, in consequence, found necessary to raise the trestles, which was a difficult operation and took some hours. The

rafts could not be brought into their position in bridge against the tide and wind by rowing, and had to be warped up one by one. This caused further delay, and it was 3.30 P.M. before the bridge was completed during a storm of wind and rain of great violence.

After a rest of less than an hour, the bridge was dismantled, but owing to a further rise in the level of the river, and consequent overflowing of the river banks, there was a delay in securing the material, and it was 11 P.M. before some of the men got back to their cantonments.

The next morning they were at work at the usual hour, 6 A.M.

The battalion of infantry quartered at Harburg, was, on another occasion, conveyed across the river in small transport rafts, in the presence of His Excellency Lieutenant-General von Treskow, commanding the 9th Army Corps.

To conclude the operations, the bridge-material was formed into large transport rafts, consisting in one case of as many as 48 boats, which were towed by steamers and formed into bridges (one over 500 yards long), at different points on the Elbe, the troops going into bivouac on the river banks.

These final operations were performed in the presence of three Inspecting Generals of Engineers who came from Berlin for the purpose.

I was much struck with the quiet demeanour and the good discipline of men, few of whom had two years' service.

The satisfactory manner in which the work was done, appeared to be in no small degree due to the constant and zealous supervision of the officers of the companies.

England.

The British new pattern pontoon is a boat with similar decked ends, and is partly decked at the sides. (Plate XL.)

The extreme length is 21 feet 7 inches, its extreme breadth is 5 feet 3 inches, and its depth amidships, including the coamings is 2 feet 8 inches.

The pontoon weighs about 800 lbs., and draws, when floating empty, 2½ inches, and when in bridge, 6 inches. Roughly speaking, every inch of immersion, gives 500 lbs. of buoyancy. The space between two pontoons, in bridge, is always 15 feet, and at this interval, the buoyancy of the pontoon is sufficient to admit of the passage of siege artillery.

The boats consist of a timber framework covered with wood and canvas, put together with a solution of india-rubber.

It is sometimes known as "Clarkson's Material," but differs from the latter in the omission of cork and leather, which were used in the original samples.

Trestles are also carried in the British pontoon train, but the pattern has not yet been finally decided on.

Various expedients have been tried with more or less success, for getting over the defect already mentioned in the two-legged (Birago)

trestles, which otherwise are decidedly the favourites with officers commanding pontoon companies.

The impression left on my mind by the trials which took place at Harburg last year, is:—

That we should have in our equipment, trestles capable of being used either as two-legged, or as tripod trestles, as circumstances might require, and trestles of this kind, of which I produce a model, are now being experimentally made at the School of Military Engineering.

The weight of a composite trestle will about equal that of a pontoon.

A unit of pontoon train consists of one troop of Royal Engineers, provided with—

20 pontoon wagons, loaded with pontoons.
4 ,, ,, ,, trestles and superstructure.

The unit (only one is equipped) is sufficient for 100 yards of floating, and 20 yards of trestle bridge.

This does not exceed half the proportion allotted to a single German Army Corps.

Our regular pontoon-train consists of a single troop of Royal Engineers, which is trained in bridging and nothing else; but all the Royal Engineer recruits are instructed in bridging-operations.

So far as the nature of equipment goes, ours is, I think, second to none, if not superior to all, in general fitness for field-service.

The quantity kept in readiness for field-service is, however, very small, and including the reserves in store, for which no men nor horses are set apart, is not sufficient to cross more than one river of ordinary width. The whole equipment, reserves and all, would not cross the Thames at Westminster Bridge, and the Thames at this point is some 50 to 70 yards less wide than the Elbe at Harburg. There two complete bridges were constructed daily.

Our arrangements for annual practice have as yet been incomplete, our pontooning has taken place either in narrow channels of still or comparatively still water, or in the case of those in the Medway, we have not as yet had sufficient equipment of the regulated patterns to make a complete bridge across the river at our practice ground.

The practice, moreover, is very much interrupted and attended with risk, in consequence of the constant passage of barges, which are subject to no special obligation to keep clear of the bridges, and in some cases are only too glad of an excuse for running them down.

For very light infantry bridges, there is not at present any recognised equipment in our service. The want is one which it is very desirable to supply, and the subject is now under consideration. Some infantry pontoons of the type of the old pattern Blanshard Pontoon are in existence, and were found very useful in the Gold Coast Expedition, but they cannot be used singly as boats, and do not supply light troops moving over ground intersected with canals or narrow watercourses, with convenient means of crossing such obstacles.

The late Captain Fowke, R.E. (whose lecture on pontoons at this Institution in 1860,[1] attracted much attention), proposed to supply this

[1] See Journal, Vol. IV., p. 237, *et seq.*

want by collapsing canvas pontoons such as shown in the model, and in certain cases these pontoons, which are very light and portable (total weight of pontoon and superstructure being about 60 lbs.) would be very useful.

Some pontoons of this pattern were sent to the Gold Coast, but they were destroyed by ants and rats before use could be made of them.

The material is therefore unsuited in such a climate.

I have, within the last few days, tried a few light pontoons of the form indicated in the model, designed by Lieutenant Elliot Wood, R.E. These boats used singly, and connected by light ladders, which for telegraph and other purposes are essential for engineer-equipments, promise to provide a safe and steady bridge for infantry in single rank.

Two boats lashed together will form a safe pier for infantry in file and light artillery passed over by hand.

The weight of each pontoon will be about 70 lbs., and of the ladders about 35 lbs. each.

I propose that one boat and two ladders, with a proportion of plank $1\frac{1}{2}$ cwt. in all, shall be carried in each wagon allotted for engineer-equipment.

This will provide means of crossing a watercourse about 18 feet in width.

Trussed girders of the form proposed by Major-General Bainbrigge, R.E., and supplied to the Gold Coast Expedition, and successfully used for connecting some of the piers of the Prah Bridge, would be very useful for passing men or guns over gaps up to 30 feet in width.

The weight of a single girder with roadway 15 inches wide is about 400 lbs. No part exceeds 11 feet in length, or 46 lbs. in weight, so that they are easily packed and carried.

Three 3-inch planks, 12 inches wide and 10 feet long, connected and trussed on the same plan answer equally well, and require less fitting and workmanship. The total weight is about 350 lbs. Of this, the planks weigh 80 lbs. each, 240 lbs. in all. The tension rods and connecting plates, &c., together, weigh about 110 lbs.

Ladders strengthened in the same way would also be useful.

I wish here to state that although for the safe, careful and scientific application of the principles of "bridge-construction" a considerable amount of technical knowledge and experience, which it is the peculiar province of an engineer to acquire, is requisite, yet the subject is of general interest, because the regulations of our service wisely lay down that all Officers, non-commissioned Officers, and men of infantry corps are to have a certain, though limited, amount of practical instruction in field-engineering, including the formation of improvised bridges of simple type.

When I was invited by the Council of this Institution to give a lecture "on Military Bridge-Construction as practised abroad," I replied that I considered it would be more interesting if I were also to say something of what is being done at home, and the Council were

good enough to accede to this proposal. I have good reason to believe that in no other nation have the means of instructing the Army at large in field engineering works, been more carefully provided for by the authorities than in our own; but I believe that if contingencies should unfortunately arise to bring our Army into collision with the standing Army of one of the Continental powers, the proportion of trained troops in the engineer branch of our service would, in the absence of any reserve liable to service out of this island, be totally inadequate to meet the demands which would be made on the corps. To provide therefore for such a contingency, every opportunity should be taken of requiring and encouraging the exercise of troops of all arms in simple practical field engineering operations, and of these none are more important than "military bridge-construction."

Owing, I apprehend, to the small number of drilled soldiers in our battalions, and to the many necessary duties and detachments, the number who have received this limited training is not as large as it would have been desirable to instruct.

It is, at the same time, necessary to guard against the tendency to count men twice over by assuming that, because they can be made useful in more than one capacity, they will, in time of war, be available for both.

I have great pleasure in testifying to the interest taken in military bridge-construction by the numerous Officers of all ranks, and non-commissioned Officers and men to whom opportunities of being instructed therein have been afforded at the School of Military Engineering.

Some of these Officers who had previously qualified for Staff employment have informed me, that they attached great value to the practical experience incident to the courses at the School of Military Engineering.

There is no doubt that the opportunities given to Officers of all arms, and especially to candidates for Staff employments of making themselves acquainted with the duties and capabilities of sister services, has, in no small degree, tended to raise the attainments of British Staff Officers to their present high standard.

It is more than ever necessary that Officers in command of mixed forces and Staff Officers should be capable of quickly appreciating the part that should be assigned to each arm in tactical combinations, and by a judicious application of the auxiliary arms, be capable of giving full effect to the offensive power of the *infantry*, on whom in recent, as in all former wars, the brunt of the fighting has fallen.

While advocating greater attention to the training of the troops in military engineering works, I wish to guard against the possible deduction that I consider this instruction should be necessarily imparted at the school with which I am connected, or at any other special school.

I am, on the contrary, of opinion that provided the regimental and company Officers and non-commissioned Officers are, as they should be, competent, instruction is best afforded to the men by those likely to be associated with them on service in the field.

I therefore consider that in this particular matter, the engineering practice of each army division ought to be conducted with the assist-

ance of the engineer troops and equipments which form part of that division, and that the operations of the military schools should be more especially directed to training the Officers and non-commissioned Officers, who are afterwards to act as instructors in their regiments and companies, and the candidates for Staff employment. I am also strongly of opinion that it should be our endeavour to assign to each military corps, duties on the efficient performance of which, their credit should depend, and that in our army there should be a division of labour, corresponding to that which, in the commercial enterprises of this nation, has produced results, *successful*, beyond parallel.

APPENDIX.—*Bridges constructed by the German Army*, 1870.

No.	Name of River.	Site.	Date of Con-struction.	Date of Demolition.	Length in mètres.	Description of Bridge and *Matériel* used.	Remarks.
			1870.				
1	Saar ..	Mettlach	Aug. 3			Pontoon equipment.	
2	„ ..	Schweig	„ 3	.. ..	100	Scratch materials.	
3	„ ..	Berncastel	„ 4	.. ..	100	„ „	
4	Sauer ..	Spachbach	„ 5	.. ..	.. ..	Foot bridge. Hop poles.	Eight bridges made here.
5	„ ..	Woerth	„ 5	.. ..	.. ..	Scratch materials.	Five bridges made here.
6	Nied ..	Etarges	„ 12	.. ..	.. ..	„ „	Four bridges made here.
7	„ ..	Parge	„ 12	.. ..	.. ..	„ „	Two „ „ „
8	„ ..	Courcelles	„ 12	.. ..	.. ..	„ „	Three „ „ „
9	Moselle	Pont a Mousson	„ 13	.. ..	.. ..	Floating and trestles. Pontoon equipment and scratch materials.	
10	„	Champy	„ 13	.. ..	86	Foot bridge. Pontoon equipment.	Afterwards made practicable for waggons.
11	„	La Lobe	„ 16	.. ..	.. ..	Pontoon equipment	
12	„	Poncé ferme	„ 16	.. ..	.. ..	„ „	
13	„	La Lobe Poste	„ 17	.. ..	89	17 trestles. Scratch materials.	
14	„	Arry	„ 17	.. ..	.. ..	Pontoon equipment.	
15	„	Corny	„ 17	.. ..	.. ..	„ „	
16	Meuse..	Charny	„ 30	.. ..	.. ..	„ „	Two bridges made here.
17	„ ..	Donchery	„ 30	.. ..	45	and scratch materials.	Two bridges made here.
18	„ ..	Nouvion	Sept. 1.	.. ..	60	Pontoon equipment.	
19	„ ..	Sedan	„ 1	.. ..	64	Pontoon equipment	Two bridges made here.
20	„ ..	Bazeilles	„ 2	.. ..	.. ..	Foot bridges. Scratch materials.	5 tree bridges over small streams.

No.	Name of River.	Site.	Date of Construction.	Date of Demolition.	Length in mètres.	Description of Bridge and *Matériel* used.	Remarks.
			1870.				
21	Marne .	Trilport.............	Sept. 13	Nov. 26....	114	Pontoon equipment and scratch materials.	
22	Seine ..	Corbeil...............	" 17	Sept. 23....	136	14 pontoons, 6 trestles....	A party of Infantry was ferried across in pontoons.
23	" ..	Villeneuve St. Georges .	" 17	" 19....	135	27 pontoons and 2 trestles	Partly constructed under musketry fire.
24	" ..	" " " .	" 18	" 30....	136	29 pontoons............	The cables had to be protected against ice.
25	" ..	Corbeil..............	" 18	Dec. 26, broken by floating ice.	128	13 trestles, 25 afterwards added. Scratch materials.	This bridge represented 4,000 hours' work. It was raised 0·55 mètres and the trestles doubled. Loaded with 240 rails.
26	Marne .	Lagny	" 18	Sept. 19....	..	9 pontoons.	
27	Oise ..	Pontoise.............	" 18	" 19....	79	13 pontoons and 3 trestles.	This bridge was constructed in 2 hours for the passage of 5th and 6th Divisions of Cavalry.
28	Seine ..	Corbeil..............	" 19	Dec. 24, broken by floating ice.	101	14 trestles. Scratch materials.	Raised and repaired in November.
29	" ..	Choisy-le-Roi	" 19	Sept. 30....	75	Flying bridge. Pontoon equipment.	Carried 60 men in 4 to 5 minutes, including time for embarking and disembarking.
30	Marne .	Gournay	" 19	Nov. 8.....	72	Pontoon equipment. Replaced by improvised trestle bridge, and remade on November 9th with pontoons.	

No.	Name of River.	Site.	Date of Construction.	Date of Demolition.	Length in mètres.	Description of Bridge and *Matériel* used.	Remarks.
			1870.				
41	Seine ..	Villeneuve St. Georges .	Oct. 12.	Dec. 24	155	22 piles. Scratch materials.	Piles were driven 2.30 mètres deep with pile-drivers mounted on rafts. Each pile took 150 hours of work, and the superstructure was 2.70 above water-level. The bridge was loaded with rails.
42	Loiret..	Olivet...............	„ 14.	.. ..	.. ..	.. ..	Substantial bridge repaired.
43	Oise ..	Pontoise	„ 21.	Oct. 25.....	82	14 pontoons and 3 trestles. Pontoon equipment.	Trestles placed between the regular trestles.
44	„ ..	„	„ 21.	„ 21.....	21	4 trestles. Scratch materials.	Permanent bridge repaired.
45	Loire ..	Toury	„ 25.	.. ..	330	Scratch materials	Afterwards lengthened to 375 mètres.
46	Seine ..	Orly	„ 30.	Nov. 3	148	21 trestles. Pontoon equipment.	As a flood was expected the flooring was much elevated.
47	„ ..	„	Nov. 1.	.. ..	.. ..	Piles. Scratch materials.	Not completed.
48	„ ..	Corbeil..............	„ 4.	Dec. 1......	130	21 pontoons, 2 trestles. Pontoon equipment.	
49	„ ..	Orly	„ 8.	„ 3......	.. ..	Flying bridge. Pontoon equipment.	Similar to No. 29.
50	Marne .	Chelles..............	„ 8.	Nov. 9.....	.. ..	Flying bridge	Substitute for No. 30.
51	„ .	Gournay	„ 12.	.. ..	80	12 piles. Scratch materials.	Flooring elevated 3 mètres above water-level.
52	„ .	Lagny	„ 13.	.. ..	70	5 piles and 7 trestles. Scratch materials.	
53	„ .	Gournay	„ 19.	Dec. 6......	98	Pontoon equipment and scratch materials.	Dismantled because it was under enemy's fire.

No.	Name of River.	Site.	Date of Construction.	Date of Demolition.	Length in mètres.	Description of Bridge and *Matériel* used.	Remarks.
54	Seine ..	Juvisy	1870. Nov. 12.	Dec. 24, by floating ice.	156	31 pontoons, 1 trestle. Pontoon equipment.	
55	Marne .	Noisel	Dec. 6	Jan. 29.....	87	10 pontoons, 2 trestles. Pontoon equipment.	
56	„ .	Lagny	„ 6.	.. ..	85	Scratch materials.	
57	Loire ..	Gien.................	„ 8.	.. ..	.. ..	Flying bridge. Scratch materials.	The continuations on the banks were 35 mètres long.
58	„ ..	Blois	„ 10.	Dec. 12... .	.. ..	Piles and boats. Scratch materials.	
59	„ ..	Beaugency...........	„ 11.	„ 13.....	240	Pontoon equipment	Constructed in 10 hours, but the bridge itself only occupied 4 hours.
60	„ ..	Saint Dié............	„ 13.	.. ..	.. ..	„ „	No. 59 repaired.
61	„ ..	„ „	„ 14.	.. ..	320	„ „	There is an island here. The bridge from the right bank to the island was made by Prussians, from the left bank to the island by Bavarians.
62	„ ..	Blois................	„ 15.	.. ..	22	Scratch materials	No. 58 restored. Hessian troops were ferried across in pontoons.
63	Marne .	Between Vaires and Noisel.	„ 19.	Jan. 28.....	109	Prussian and Saxon pontoon equipment.	Dismantled for a few days on account of ice.
64	Loire ..	Orleans	„ 23.				
65	Seine ..	Villeneuve St. Georges .	„ 27.	Jan. 19.....	.. ..	Bridge on the ice. Pontoon equipment.	The level of the ice was artificially raised and the surface roughened.

Evening Meeting.

Monday, June 7th, 1875.

ADMIRAL SIR HENRY J. CODRINGTON, K.C.B., in the Chair.

METHODS OF ASCERTAINING THE RELATIVE VALUE OF COALS FOR NAVAL PURPOSES.

By E. ECKERSLEY, Esq., Chief Engineer, R.N.

COAL is a substance which during modern times has played a very prominent part in the naval and commercial history of the world; and taking into consideration the amount exported from these shores, I think I may fairly assert,—that from our coal mines is drawn the greater portion of that fuel which is the real motive power of the steam-engine.

Officers are sometimes placed in positions in which it would be beneficial if they could form a just estimate between different qualities of coal. This is my excuse for attempting to describe a few of the methods by which scientific men approach this subject; coupled with my own practical experience and observation.

So many eminent men of science have written upon the subject, What is coal? that I could hardly take up your time in giving a detailed account of their various theories.

All are agreed upon this one point, that coal is of vegetable origin; and the greater portion consider it but the decomposed remains of a luxurious vegetation which this country possessed at a distant period. This being so, you can understand with what rapidity, ferns, lichens, rushes, and such like plants grew; the air then containing more carbonic acid—"now about four parts in ten thousand"—more moisture, and the heat more intense.

In the spring these plants increased enormously, but as winter approached numbers died; the next year they were succeeded by others, quantities of which in their turn also died, and so were produced layer upon layer; the whole eventually becoming covered with earth, by the streams carrying it down the hill sides, or by a sudden upheaval, and in time we find this vegetable substance, changed to the different

be 60; "a difference of 50 tons;" and as the price of coal during my period of service there was nearly £4 per ton, we should by choosing that containing the greater portion of water, be paying a difference of £200 for a thing (water) which was detrimental, and which could be easily obtained over the ship's side, if wanted, without charge. Unfortunately this loss does not end here, for a certain amount of the carbon will be required to evaporate this water, without giving heat to the boiler; thus more heat is dissipated, or in other words, so much more loss.

As a proof that I am much within the average, I call your attention to a table made by Professor Whitney, on coals on the Pacific Coast.

Proximate Composition of Cretaceous Coals.

	Monte Diabolo.			Bellingham Bay, Washington Territory.	Naniamo, Vancouver's.
	Clarke & Co.	Black Diamond.	Cumberland.		
Water	13·47	14·69	13·84	8·37	3·98
Bituminous substances	40·36	33·89	40·27	33·26	32·16
Fixed carbon	40·65	46·84	44·92	45·69	46·31
Ash	5·52	4·58	0·97	12·68	18·55

To make it still more striking, I may quote the case of a lignite from Bovey, Devonshire, where 34·66 per cent. of water was found in the analysis.

This proves that there must be a great variation in the amount of water contained in coal; the method by which we may ascertain this amount is simple.

Clean and heat to redness a porcelain crucible; allow it to cool under a bell-jar, and then weigh accurately on a balance;—the more sensitive the balance is the better;—chemists generally use one which is capable of weighing to the $\frac{1}{1000}$ of a gramme (·015 of a grain). Introduce into the crucible from one to two grammes of finely powdered coal; again weigh, the difference between this and the previous weighing represents the amount of coal used.

Place the crucible, with its cover removed, in a water-oven similar to the one you see before you (Fig. 1), or expose it to a temperature of 212° F.; let it remain exposed to this temperature for at least two hours, then allow it to cool under a glass or bell-jar by the side of sulphuric acid, and again weigh.

After weighing, return the crucible to the water-oven, and expose for another half-hour; if at the end of this time, the weight is the same as before, the loss which the coal has undergone represents the moisture contained in it; if the weighing is still lighter, then it must be again placed in the water-oven, until two weighings, at intervals of

To obtain this quantity, you weigh in a crucible about a gramme of coal, in a similar manner, to that for obtaining the moisture. The crucible with the coal in it, is, instead of being exposed in a water-oven, supported on a triangle above a Bunsen's burner, the flame of which must be exceedingly small at the commencement; the cover of the crucible is to remain on; as the coal becomes heated, gas and smoke will be observed to issue from the crucible, the evolution of which must be carefully moderated so as not to carry away any of the solid particles; as the gas and smoke become clear, the heat may be gradually increased, until the whole crucible becomes red-hot; the lid should then be removed and placed in this position, Fig. (2), in order to produce a current of air in the coal, and, by this means, to burn up the carbon. The coal should occasionally be stirred with a platinum wire, and the operation of heating is to be continued until the ash of the coal is of an uniform grey, or reddish appearance, and red-hot throughout. When this is the case, the crucible is removed and allowed to cool under a glass jar and weighed. The difference between this weight and the weight of crucible, plus weight of coal, will give the ash obtained from the amount of coal used.

Then calculate, as before, the percentage.

The ash generally contains iron, silica, sulphur, and phosphates in various amounts. In passing, I may as well observe that the value of ashes for agricultural purposes depends upon the amount of phosphates they contain.

Iron and silica are of so little moment for our purpose, that I will not take up your time in describing them.

Sulphur.—This being a substance very detrimental to iron, at least merits some attention, and I have no hesitation in stating that it is the cause of much injury to boilers.

It is well known that if you take a stick of sulphur, you can force it through heated iron; such is the property it has of combining with certain metals.

Whilst Engineer-in-charge of Her Majesty's gunboat "Fervent," then lying at Bristol, I was much troubled with the boiler-tubes going in small holes about the size of a pin's head, thus utterly destroying them for practical use; and my time was fully occupied in replacing them by others. I consulted some of the best practical authorities, both in Bristol and elsewhere, but could not come to any satisfactory solution of this peculiar phenomenon. However, in my chemical studies I came across things of a similar nature; and, having consulted Dr. Debus, Professor of Chemistry at the Royal Naval College, upon this subject, he advised me to get some of the coal used as well as a portion of the tube. Unfortunately I could *only* obtain a small quantity of the coal, which I found to contain a large quantity of iron pyrites, and have come to the following conclusion:—

Whilst the coal was burned in the ordinary manner, without using the blast, the greater portion of the sulphurous acid escaped up the chimney, with little or no injury to the tubes; but, as soon as the blast was put on, thus causing an increased velocity in the products of combustion, particles of these pyrites were carried into, and

short time, then allow to cool, and when cool, dissolve the whole mass in water, taking care that none either of the fused mass or of the water is lost; if this should be the case, the experiment is vitiated. Then boil the mass up with water in a glass beaker, and add hydrochloric acid, *very gradually*, keeping the beaker covered with a watch glass or glass plate, and frequently stirring the mixture. When the contents exhibit a decided acid reaction, filter through a good piece of filter-paper, wash the beaker out two or three times with distilled water, pour this through the filter-paper, and finally, wash the paper itself.

The solution or filtrate so obtained must then be heated to the boiling temperature, and a solution of chloride of barium added. This will cause the solution to become turbid, viz., will throw down a precipitate of barium sulphate. This is now to be put on one side, and allowed to remain for twelve hours, until the sulphate of barium has settled. The substance must then be filtered through a piece of fine filter-paper, the beaker well washed out, as well as the precipitate, with hot, distilled water. Afterwards dry the filter containing the precipate in a water-oven, shake the precipitate carefully into a weighed crucible (this should be done on a piece of glazed paper), roll up the filter-paper, and twist a platinum wire round it, then burn the filter-paper in a flame, and add the ash to the crucible. Heat the crucible to redness, over a flame, allow to cool and again weigh; the increase of weight will give the amount of sulphate of barium obtained from the weight of coal used, from which the percentage of sulphur may easily be calculated, thus:—

Sulphate of barium = $BaSO_4$, the atomic weight of which is—

$$\begin{aligned} Ba &= 137{\cdot}5 \\ S &= 32{\cdot}0 \\ O_4 &= 64{\cdot}0 \\ \hline & 233{\cdot}5 \quad (BaSO_4) \end{aligned}$$

$$233{\cdot}5 : \text{weight of } BaSO_4 \text{ found} :: 32 : S$$

$$\text{Then as weight of coal} : S :: 100 : \text{percentage.}$$

or

$$\frac{(BaSO_4) \text{ found} \times 16 \times 100}{116 \times \text{coal taken}} = \text{percentage of S.}$$

We now come to the most valuable part of the fuel, namely, carbon; for that which contains the largest quantity, under ordinary circumstances, is the best for heating purposes.

The most practical method of testing it is that adopted by Berthier, and known as the litharge test. It consists in taking a small quantity of finely powdered coal, and mixing it with thirty times its weight of litharge (Pb. O). This is placed in a crucible, and covered over with an equal quantity of litharge. The crucible, covered and placed in a furnace, or over a Bunsen's flame, for a period of twenty minutes, or

until the gases have ceased to bubble through the covering of fused litharge.

The crucible should not be more than half full, and care should be taken not to use the flame too strong at first. A button of lead will now be found at the bottom. The crucible should then be tapped slightly, so as to throw down any globules of lead that may have remained in the fused litharge. When cold, the crucible is broken, and the button of lead carefully cleaned, and weighed.

It is generally asserted by chemists that the results so obtained fall short of what they actually should be, by an amount nearly equal to $\frac{1}{8}$.

The percentage of carbon is ascertained as follows:—Litharge contains 207 parts of lead and 16 parts of oxygen, and when subjected to the heat of a furnace, in presence of which carbon has a greater affinity for oxygen than lead, the carbon from the coal will combine with the oxygen in the litharge, and pass off as carbonic acid, leaving the lead at the bottom of the crucible in the following proportions:—For every 1 part of oxygen evaporated, 13 of lead will be formed. For every 12 parts of carbon, there will pass off 32 parts of oxygen; or 1 part of carbon mingles with 2·666 of oxygen to form carbonic acid.

Let x = quantity of oxygen taken from the litharge by the carbon in the coal. Let b = button of lead found, then $13 : 1 :: b : x$, or $\frac{b}{13} = x$; and $\frac{x}{2{\cdot}666}$ = quantity of carbon contained in the coal used. The percentage of carbon can then be ascertained.

Example.—Find the percentage of carbon in a button of lead weighing 300 grains. Coal tested 10 grains: $\frac{300 \times 16}{207} = \frac{300}{13} = 23{\cdot}07$ parts of oxygen and $\frac{23{\cdot}07}{2{\cdot}666} = 8{\cdot}65$ parts of carbon passed off for 10 parts of coal.

Therefore $10 : 100 :: 8{\cdot}65 : 86{\cdot}5$ = percentage of carbon.

This method, although admitted to be unreliable for original tests, in consequence of the difficulty of obtaining commercially pure litharge, as well as being based on the assumption that carbon is the only combustible substance in coal, is undoubtedly valuable, from its simplicity, and, in the hands of practical men, could always be used to test one coal against another—that coal producing the heaviest button of lead being the richest in carbon.

It has been found that pure carbon gives a button of lead 34·5 times its own weight; therefore if a sample of fuel gave 25 times its weight, $\frac{25}{34{\cdot}5}$ should equal the percentage of carbon when multiplied by 100.

Berthier and other experimenters have given the following table:—

Coking Dowlais coal ..	gives	31·8	times its	weight of lead.
Glamorgan	„	31·2	„	„
Newcastle	„	30·9	„	„
Wigan coal	„	28·3	„	„
Cherry coal, Derbyshire	„	27·2	„	„
Glasgow Cannel ..	„	24·9	„	„
Durham	„	31·6	„	„
Pennsylvanian anthracite	„	30·5	„	„

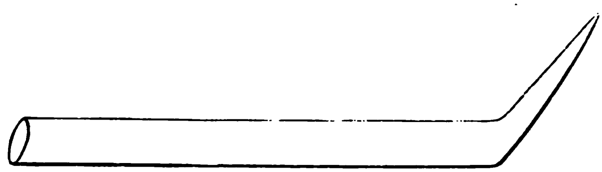
By a comparison with these figures an experimenter can judge of the fuel used.

The most accurate method for the ultimate analysis of organic substances is that adopted by chemists for the estimation of the carbon in coal.

The following apparatus is required, which I have placed upon the table:—

Combustion tube (Fig. 3) made of hard and annealed glass, in which

FIG. 3.

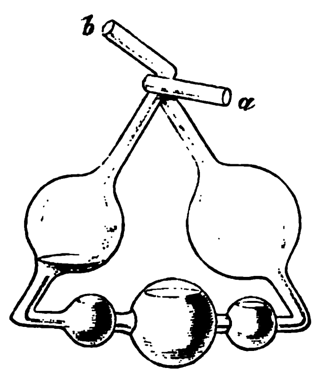


the coal is burned. Before using, it must be thoroughly cleaned and dried, by passing it rapidly over a flame, and sucking out the heated air by an inserted glass tube; when this is done it should be corked till required.

A small glass tube closed at one end to contain the coal, the cork of this should be covered with tinfoil.

Set of Liebig's potash bulbs, filled with a clear solution of potash, as free as possible from carbonate of potash, sp. gr. 1·27 up to $\frac{1}{3}$ of lower three bulbs, Fig. 4. Care should be taken when filling the

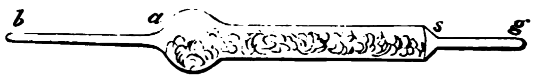
FIG. 4.



bulbs that only the end marked (*a*) should be inserted in the liquid; the bulbs are filled by applying suction to draw in the solution, the ends then perfectly dried with twisted bits of filter-paper and the outside with clean cloth.

A calcic chloride tube (Fig. 5), which must have a small portion of

FIG. 5.



cotton wool inserted before filling with calcic chloride.

When filled within three-quarters of an inch of top, another piece of wool should be inserted, and then closed with a perforated cork, through which a narrow glass tube passes; the protruding part of the cork cut off, and end covered with sealing.wax.

A furnace, in which the combustion tube is heated.

A quantity of fuzed chromate of lead, kept in a dry corked tube.

The process is as follows:—Weigh the potash bulbs and calcic chloride tube separately; then insert in the combustion tube some chromate of lead; add to this about half a gramme of dried coal, ascertaining the exact quantity by weighing the tube containing the coal, before and after the addition; then more chromate of lead, which must now be intimately mixed with the coal, using a clean wire, formed at the end like a corkscrew.

The contents of the tube are now placed so as to allow the gases to pass over the top, which can be done by gently tapping the tube on a table; then connect the calcic chloride tube by means of a dry perforated cork to the combustion tube, and the potash bulbs to the end of the calcic chloride tube with a vulcanised india-rubber tube. The potash bulbs should be carefully handled. The whole is now placed in the furnace, the bulbs resting on a piece of folded cloth. It is then requisite to test by slightly heating the bulbs, and allowing to remain a few minutes, whether the whole is air-tight. The furnace is then lit, and the number of gas-jets gradually extended until the whole is red hot. During this period the carbon of the coal will combine with the oxygen of the chromate of lead, and pass off as carbonic acid, but will be absorbed by the solution of potash; the hydrogen of the coal also combines with some more of the oxygen and forms water, which is absorbed by the calcic chloride. This operation should be performed so that the bubbles of CO_2 should only pass into the bulbs at about half second intervals. When the bubbling has entirely ceased, the pointed end of the combustion tube should be broken off with a pair of pliers; covered with a small glass tube about two feet long, and the CO_2 contained in the combustion tube sucked carefully through the potash solution. During the analytical process the bulbs must be kept in a slightly oblique position.

The potash bulbs, and calcic chloride tube, are now disconnected and re-weighed, the difference of weight in each case giving the amount of CO_2 and water produced. The calculation is now simple.

To find the carbon from the atomic weight of carbonic acid.

$$\begin{aligned} C &= 12 \\ O_2 &= 32 \\ \hline &\ 44 \end{aligned}$$

Then as 44 : weight of CO_2 : : 12 : weight of C, you can then, knowing the weight of carbon in a given weight of coal, calculate the percentage.

In a similar manner the hydrogen can be found.

H_2O, which is absorbed in the calcic chloride tube—

$$\begin{aligned} H_2 &= \ \ 2 \\ O &= 16 \\ \hline &\ 18 \end{aligned}$$

Then as 18 : weight of water : : 2 : weight of hydrogen, and, as before, knowing the amount of coal used, and hydrogen in that coal, the percentage also obtained.

Nitrogen is of such little moment that I will not take up your time in describing the tests for it, but proceed to an instrument, which I think should be in the hands of all persons who purchase large quantities of coal.

I allude to the calorimeter invented by Mr. Lewis Thompson. It consists simply of a glass cylinder, graduated to hold 29,010 grains of water, a combustion cylinder of brass, with stem and stop-cock, with spring clutch-base, copper furnace, and thermometer.

In using it, we assume the latent heat of steam to be 967° F., and that coal burned in oxygen gives off as much heat as when burned in air.

If we heat 967 parts of water 1° F., we expend as much heat as if one part of water were boiled off from 212° F.

Similarly, if heated 10° F., the heat would have been enough to have boiled off ten parts of water, the thermometer thus indicating the number of parts capable of being boiled off by the heat. If one grain of coal were burned in 967 grains of water, the temperature would show the number of grains of water the coal in question would convert into steam; by using tons, or pounds, instead of grains, we could thus find how many tons or pounds of water a ton or pound of coal would evaporate, thus giving an approximate value of its evaporative power.

In this instrument there are thirty grains burned, therefore the amount of water is increased thirty times, namely, to 29,010 grains. The coal used must be finely powdered, and passed through a hair sieve. Thirty grains of this powdered coal are then weighed in a perfectly dry state, and mixed with ten or twelve times its weight of a mixture composed of three parts of chlorate to one part of nitrate of potash; this is generally termed an oxygen mixture.

The coals must be reduced to powder separately, as the mixture is liable to ignite if pressure is used. Then intimately mix them and

place in a narrow copper furnace, tapping so as to fill it. The furnace is then placed in its position, and a hole made in the mixture to receive a fusee, which is fixed by pressing the mixture round it.

The temperature of the water is now taken by a delicate thermometer, and the fusee lit; cover with condenser, and quickly insert the whole under water, the stop-cock having been previously closed. This must be done smartly or it is dangerous, should it take fire in the air, perhaps burning the operator. It is generally found that if the water is about 60° F. before the experiment, the results are most reliable.

When combustion has ceased, the condenser is moved up and down to mix the water, and the stop-cock opened, from which air should issue; a thermometer is then quickly inserted, and from the temperature observed, the approximate evaporating value of the coal is calculated.

Each instrument itself absorbs a quantity of heat, which is ascertained by the making, and must be added to the result. The one before you absorbs 10 per cent. I will now, with your permission, perform this experiment.

There are other different kinds of calorimeters, one in which oxygen is carried into the combustion-chamber by a pipe, and the heated coal burned under water by these means; afterwards the calculations are then made in a similar manner to those used for Thompson's calorimeter.

Another form is a modification of that used by Rumford, Favre, and others, and as all these instruments have a kindred action, I will describe the one used at the Naval College.

A rectangular box of sheet iron made water-tight, 2 ft. × 2 ft. × 18 inches; within this is placed a small furnace about 5 inches square, in which fuel can be burned; to the top of the furnace is attached a copper tube, one inch in diameter, which coils round inside the calorimeter, and finally issues out at the top; through which the products of combustion pass. There is a fan in the interior which can be moved so as to mix the water intimately. The calorimeter must then be weighed, and filled with a known quantity of water. A pound of coal is burned in the furnace carefully; taking the temperature of the contained water at the commencement and end of the experiment. A similar calculation is then adopted as for Thompson's.

The weight of the calorimeter must be multiplied by the specific heat of iron, namely, ·113, and the amount considered as so much more water raised in temperature.

Care must also be taken, that the gases only issue into the atmosphere slightly in excess of the temperature of the surrounding air.

A good practical method is adopted in our dockyards, in order to test the coal as it arrives. A tank is fitted which contains a known quantity of water; this is allowed to run into a boiler, and is there evaporated; known by having certain marks on the gauge glass. The coals used for this experiment are weighed as well as the ash made; and then its evaporative power can be calculated.

As these experiments are generally made in a special boiler, under

similar conditions, by the same person in each dockyard, I am sure they would make a valuable table of reference if published.

However, most of these testing apparatuses are too expensive for general use, but in the hands of ready manipulators, the Admiralty, or other large purchasers of coal, have in Thompson's calorimeter, a ready approximate method of testing the evaporative value of different kinds of coal. For practical men, the tests for water, ash, and the litharge-test for carbon, with the aid of the calorimeter, will, I am sure, be sufficient.

It often happens that an officer in Her Majesty's service, may have a piece of fuel given him in a far off land; with these tests he will certainly be able to form an approximate estimate of its value for the services, and by these means perhaps aid our ever-increasing steam fleet, which, as time rolls on, will require more and more coaling stations. If we can thus obtain supplies from other countries, we shall have more left for our home consumption, without which England must sink to the position of a second-rate power.

Devoid of coal we should be unable to compete with other nations in the production of those useful articles of commerce, which supply the very sinews of our maritime prosperity.

Mr. G. A. Tuck, R.N., Instructor in Steam, Royal Naval College, Greenwich: It would be a pity to let this subject pass over without some few remarks, especially as there are so many naval engineers present. However, a paper of this kind is for the benefit of sea-going men as a rule, therefore I should like to offer a few remarks as to what we may consider its value in a practical sense afloat in those foreign parts where we are accustomed and obliged to take coal as we can get it. I must say I do not feel at all able to question any point in this paper. I understand it to a certain extent, but it is to me a chemical paper on the subject of coal; it is an analysis of coal chemically illustrated. It also represents how much has been done in the Royal Naval College when we find such a paper as this written by one of the pupils of Dr. Debus and his assistants; it shows clearly, at any rate, that they have studied deeply a subject which is of vast importance to the naval engineer. But I am not so sure that if placed in the hands of a practical man, or a man dealing with the coal afloat, he would look upon it in any other light than as a satisfaction to see what can be done in the laboratory, and it will be also a satisfaction to know that all this that has been done in the laboratory is totally unable to be performed afloat. In the first place, in dealing with the coal, we have the calorimeter made up as a boiler, and in this calorimeter we get the power of the coal. Now I, of course in the Navy, have seen from time to time various scientific means used for burning this coal, that is to say, to make a more perfect combustion, in order to realise the value of the carbon in the coal. But what has been the result of all those introductions? After all we have found that we have been obliged to fall back upon the skilled labour of the men, that is to say, trained stokers are far better adapted to deal with this question, although they know nothing at all about the theory, than all the so-called scientific introductions that we have had from time to time for burning coal. I remember perfectly well a chief engineer being asked by an Admiral what he thought of all these introductions, meaning the arrangement for burning the so-called Baxter's mixture, and what effect it had principally in consuming smoke. "Yes," he says "smoke-consumers "without doubt, but steam destroyers," meaning by this that although they got rid of the smoke the combustion was so bad in another direction that coals were used without heating power, and without giving us the quantity of evaporation that they would under the ordinary conditions of the simple stoker dealing with the coal. It has been my fate in the course of my service to be called upon to report

on coal, especially when opening up Japan. I was sent out there in 1857 with an Officer from the Royal Engineers, in order to try the coal practically, in case all other methods should fail in getting any knowledge of the matter. All the tests that could be got at by the chemist were tried, especially the litharge test. This was an entire failure on all points, I suppose, because of the adulteration of the litharge, preventing anything like truth being come at as to any quality of the coal. That is to say, we would take the same quality of coal, try it under the same conditions, and find different results each time, although apparently it was the same coal. Chemical tests of course we had not. I believe Professor Thompson's machine has been introduced since that time, but I do not think that if I had all that is now known, and which has been so carefully placed before you, that that would have enlightened me or helped me one bit to have carried out the real comparisons that were drawn as to the value of the coals for the several classes of vessels that we had to deal with. This chemical test I should have put on one side altogether. It would have been a great gratification to me to have had this paper, because I should have known then the chemists could not have done anything at all, whereas under the conditions I was in, I did not exactly know what they could do. Therefore I consider this going into the hands of the engineers of the service will be a very great boon to them indeed. Men who have not had a chance of going through a course of chemistry will be glad to have this paper placed in their hands, and they will summarize the whole, and see how much can be done with coal. It is a difficult matter to discuss this paper, but I did not like to let it pass without some few remarks.

Mr. THOMAS W[illegible], Demonstrator in Chemistry, Royal Naval College, Greenwich: With your permission I should like to make one or two remarks from a chemist's point of view, seeing that the subject, as it has been treated by Mr. Eckersley to-night, is essentially a chemical one. There can be no doubt whatever that any fresh knowledge regarding the materials which at any time may have to be used, will be of value; it will invariably lead to a more satisfactory use, economical and otherwise, of such materials. This is the direction in which the greatest advance has been made during modern times in our productive industries. Manufacturers have come to see that it is to their interest to know all they can about the raw material which they use; and in this way they are able to work upon a more or less scientific basis, and so to obtain the best results they can, and at the same time to prevent unnecessary loss. It is very much to be regretted that in the case of such a substance as coal, used in such immense quantities and for such diverse purposes, that at present there are no accurate and ready methods for its valuation, not only in this department, viz., in its application for the production of mechanical power in the steam engine, but also in its use as a means of obtaining warmth and heat, and also as a means for obtaining artificial light. In neither of these directions is there any ready and accurate means for determining the value of coal for that particular purpose for which it is required. There are methods, and they are theoretically accurate, and in some cases absolutely accurate, but they are not by any means ready; they are not quick in operation, not at all adapted for use in a commercial sense, and this seems to be the difficulty, that either accuracy must be given up, or celerity; we cannot have accuracy and quickness at the same time. The method Mr. Eckersley has introduced to you this evening, that of burning coal with chromate of lead, is a perfectly accurate method; it is the one which is adopted by chemists for the ultimate analysis of organic substances, by which they obtain an insight into the constitution of an organic body, and are able in that way to write down its formula, but although so accurate, that process is a very tedious one and requires several hours and a great amount of care for its completion, because it is the case that as you increase the accuracy of the result, you increase the amount of care which it is necessary to take in the manipulation; and a test of this description would be useless if it had to be applied in commercial operations. The litharge test of "Berthier," and the test with Thompson's calorimeter, may not be, and are not accurate, but they are made with very great care. It is quite possible the inaccuracy in these tests may not be greater than the inaccuracy in the combustion of the coal itself; for I believe it to be probable that in no two cases would a quantity of coal be found to burn alike, unless experimental conditions were resorted

to. So many matters come into play to influence and prevent the coal from giving out precisely the same amount of heat on two occasions; the arrangement of the furnace, the amount of air admitted, the heat of the furnace when the coal is put in, the thickness of the layer of coal, all these things and many others have to be absolutely alike before we can obtain two results that will be similar, because being such a complex substance it is capable of undergoing a variety of different decompositions, and under different circumstances will decompose into various products of different value. The combustion-test, with chromate of lead, is based upon the supposition that the whole of the carbon is burnt to carbonic acid. This is not the case when coal is burnt under a boiler, where the heat if it is to be of any value, must be evolved at a particular spot. The coal is burnt partly into carbonic oxide and partially into carbonic acid; the carbonic oxide is afterwards burnt into carbonic acid, but this takes place frequently only after it has passed away from the spot where the heat is required. The litharge-test is especially inaccurate when heavy stove-coals have to be examined, such as anthracite or South Wales coals, where the oxygen contained in the coal is very much less than the hydrogen. In one of the tables used by Mr. Eckersley, you have stated the carbon, hydrogen, and oxygen contained in wood, peat, and coal, and in the wood there is very nearly the theoretical quantity of oxygen to burn up all the hydrogen. Every one part of hydrogen would require eight parts of oxygen, so that it should be 96 of oxygen, instead of 83. Now, as long as the hydrogen and oxygen exist in the proportions in which they form water, none of the oxide of lead will be reduced to metallic lead by the hydrogen. But as you go down that table the amount of oxygen in proportion to hydrogen gets less; and, as it gets less, you have an excess of hydrogen which will reduce the oxide of lead. This excess of hydrogen is about four times as valuable in its heating-power as the carbon itself; and hence, in using the litharge-test, you would be estimating the calorific value of hydrogen as if it were carbon. This is one of the inaccuracies in the case of the litharge-test.

With Thompson's calorimeter there is always a proportion of heat goes off with the gases; the combustion is so energetic that the water cannot absorb the heat rapidly enough. But supposing the inaccuracies of these two methods not to be greater than the inaccuracies of the combustion of the coal, then they can be applied for estimating its value.

Again, I take it that coal is never required to be valued absolutely, it is nearly always a relative result which is wanted. You have two or more coals, and have to judge which is the best for your purpose. You are not asking the value of a particular coal, but relatively to another coal, how much carbon or sulphur does a certain sample contain. Taking even an inaccurate method, if the conditions are fulfilled in both cases, the inaccuracy will be the same in both cases, but the difference will be absolute and correct, so that you can form a very good estimate between the two coals. With regard to taking samples of coal, this is a very important point, because upon the sampling of the coal depends all the after-tests which we have had here mentioned. The coal must be sampled very carefully. A large quantity should be obtained, as much as one hundredweight at first, and the lumps which occur in greatest number and of a similar size, should be taken first, and a number of these should be put together and broken up into smaller pieces; these smaller pieces should be thoroughly mixed, and a certain number of these taken and again broken up, the residue mixed, and then pieces picked out again, and broken again, and mixed again, and so on until you have reduced the coal down to a fine, almost impalpable dust, and then this may be considered as a sample of the coal. Even when such precautions as these are taken, occupying a considerable time, it sometimes happens that a sample will not show the homogeneity it ought to do if it is to be considered as an absolute sample.

Captain Burgess: I should like to ask what the apparatus on the table if supplied to a ship is likely to cost?

Mr. Eckersley: About £5, I believe, is the value, and if the balance was made a little more sensitive, and the thermometer a little more sensitive, it would be beneficial for all the other tests.

The Chairman: Before asking you to thank Mr. Eckersley for his lecture, I should say I quite agree that in actual practice it is not so much the particular

value of any sort of coal that is required, as its relative value compared with other coal that can be obtained in the market abroad. These experiments and all this accurate information are of very great use, even supposing we could not make them accurately on board ship; but I myself see no reason why we should not make these experiments on board our ships with considerable, if not perfect, accuracy. At any rate it is of great importance first of all to know what is in the coal, what quantity of heating materials we can get in a given fuel; then, having got that, to know how we can best apply the means at our disposal, that is to say, the furnaces in our ships to that peculiar fuel; and then comes in, what one of the gentlemen who favoured us with his opinions is quite right in saying, is the rough and ready and practical experience of the stokers how best to use that coal in the furnace which is at their disposal. We may find that by a little alteration of a furnace we may make a coal which is, comparatively speaking, unsuited to the furnace in its first form, well suited to it with a slight modification. That is decidedly the Engineer's Department on board of that ship. I think, not to occupy your time too long, that we have gained a great deal of information already from the lecture we have heard, and that all who go to sea will be able to turn that information to greater advantage now that we know more on the subject. You will all join with me, I am sure, in thanking Mr. Eckersley for his very able and interesting lecture. He is not only very well informed himself, but he has elicited information from others which we are all very glad to hear.

PROPOSED PLAN OF CANVAS PONTOONS TO BE MADE OUT OF SHIP'S STORES.

Contributed by Lieut. Arthur Moore, R.N.

These pontoons could be utilized as follows, viz. :—

1stly. Rafting bodies of men in shallow water, or through surfs.
2ndly. Transporting heavy weights in shallow water.
3rdly. Increasing the buoyancy of a raft.
4thly. As impromptu camels for raising sunken vessels.

To float a weight of approximately 6 tons, 2 portions of double No. 1 canvas, 12 feet long, should be made, and coated with the following solutions.

	Solutions.	*Mode of Application.*
For the seams.	1. Gutta-percha dissolved in naphtha.	To be rubbed between the parts of canvas before sewing.
For the seams.	2. 6 lbs. of glue dissolved in boiling water, and mixed with 10 lbs. of whiting.	To be rubbed on the inside of the seams after sewing.
	3. 3 gallons of linseed oil, $1\frac{1}{2}$ lbs. of rosin, $\frac{1}{2}$ lb. of yellow soap, 1 lb. of litharge.	To be put on hot over all, working well into the seams.

And a final coat of black paint on the outer part.

Two cloths on top, one at bottom, and one on the sides, meeting at either end. The two parts should be cut out the same, but in sewing, the seams of the inner part should be broader than those of the outer. The ends to be rounded off at 18 inches, to avoid corners. The canvas to be sewn close on the inside with an inch seam, tabled and stuck on the outside, using a small needle with the edges smoothed. The hose to be on one side made of double canvas, one part first sewn on the inside, then turned inside out, and the other part sewn to the outside very close. The hose of the inner part coming up inside that of the outer.

The top to be sewn to the sides first, and the bottom going on last.

Application.

In all cases of transporting, rafting, &c., the pontoons must be connected together abreast with poles. To secure these, three or four

bands of canvas should be made to go taut round the pontoon when inflated fore and aft. Loops of canvas to be sewn on these bands, and also on the seams at either ends where the side cloths meet. Two poles to be rove at top and two at bottom, through these loops, and a flat piece of wood through the loops at the ends to make stern pieces that will protect the canvas from chafe, and to which the fore and aft bands of canvas should be secured, so that the pontoon, when in motion, would not chafe or slip out of the bands. Four short cross-pieces to be lashed underneath, and at right angles to the bottom poles, to keep the pontoon off the ground, and four cross-pieces to be lashed to the poles on top of each pontoon to connect the two together. The length of these last to be determined according to the distance the pontoons are required apart.

In transporting or rafting, a suitable platform should be made to rest on, and be secured to the cross-pieces connecting the pontoons.

In utilizing the pontoons as impromptu camels, the simplest plan would be to secure them when empty under the beams of a ship independently, and then inflate them. For this service they could be made of almost any size, and, if required in as short a time as possible, one part of canvas and two good coats of Stockholm tar might suffice.

For increasing the buoyancy of a raft they would be used in conjunction with the spars, which should be arranged so as to leave a clear space where the pontoons could be placed without danger of chafe. The bands and poles should be placed as before, the cross-pieces being securely lashed to adjacent spars of raft.

Experiment.

A partial experiment was tried at Trincomalee in November, 1873, and tested as follows:—

1. Placed empty under a 27 feet cutter, with 13 ten-inch shell, and 8 men in her. The boat was lifted easily.
2. Placed empty under the stern of an iron lighter 50 feet long, 15 feet beam, flat-bottomed. The stern was lifted 10 inches, leaving 4 inches of water under the lighter 10 feet from stern.
3. Two anchors, weighing together 62 cwt., were lowered on the pontoon, and purchases overhauled. The anchors sunk as far as the flukes, so actual weight sustained was about 50 cwt.

The results were satisfactory, considering the incomplete apparatus used, which consisted of a single pontoon ($11\frac{1}{2}$ feet long) instead of two, and that made of single canvas. The sole defect noticeable was in the seams, where an escape of air was apparent, but this would not be the case with double canvas. The canvas itself was perfectly air-tight.

The diver's air pump was used to fill the pontoon.

LECTURE.

March 12th, 1875.

Admiral Sir ALEXANDER MILNE, G.C.B., &c., &c., Lord of the Admiralty, in the Chair.

THE VOYAGE OF H.M.S. "CHALLENGER," (*continued*).

By Dr. CARPENTER, C.B., F.R.S., &c., &c.

MR. CHAIRMAN, LADIES, AND GENTLEMEN,

WHEN, about two years ago, you did me the honour to invite me to deliver a lecture on the voyage of the "Challenger," I was able to speak of little more than what was intended to be done: we had but one instalment, and that a small one, of what had been actually done; and my endeavour then was to explain to you the scientific objects of this very interesting expedition. I pointed out that these were essentially twofold, namely, *first*, the exploration of the Deep Sea as regards its Physical conditions, especially its depth, its temperature, and its composition, together with the study of the nature of the ocean-bottom, which has proved to be of peculiar interest and importance; and *secondly*, the search for the various forms of Life with which we believed that bottom would be found peopled even to its very greatest depths. I am now able to tell you a great deal of what has been done; and I shall chiefly dwell in this lecture upon the first part of the subject, because it is that with which, so far, we have been made most acquainted. By the kindness of the past and present Hydrographer to the Admiralty, I have been kept always supplied with the results of the observations forwarded from time to time by Captain Nares, as to the depths, temperatures, and specific gravities ascertained by his soundings; and these results are presented to you in these large diagrams, which contain most of the temperature—sections, at least of the Atlantic, prepared by the Officers of the "Challenger." The animal collections have been far larger than was at all anticipated. The Hydrographer to the Admiralty told me that when the "Challenger" went into Hong Kong, every jar and bottle in the ship was filled up with collections made since the ship left Sydney; and as I had been over the ship, and knew the enormous storage there was, I could form some idea of the magnitude of these

collections, which are now on their way home. Those forwarded from the Cape and from Sydney have already been received; but it has been thought preferable that these collections should remain in store till the return of the "Challenger," when Professor Wyville Thomson will arrange them, and distribute them to various scientific men according to what is suitable for the investigation of each. Still we know a good deal in general terms of the success of the second part of the enquiry which the expedition was charged to prosecute; a great number of new and very singular forms have been discovered; and, what is perhaps not less interesting, we know that a number of specimens have been obtained of types of which one or two only had been previously brought to light, and which, from their very anomalous character, had excited great interest amongst naturalists. Some of these have been examined by the naturalists of the "Challenger," and accounts of them have been [published; but any description of them would be too technical for a lecture like the present. I shall confine myself, therefore, as regards what I have to say upon the animal life of the deep-sea bottom, to a point which has recently been brought into considerable prominence, the nature of the deposit at present going on upon the bottom of the Atlantic.

In the first place, I shall revert to the problem which it was one of the chief objects of the "Challenger" expedition to solve: the distribution of Temperature in the deep sea. This distribution is obviously the clue to those great movements of ocean-water, which are too slow to be detected by any ordinary mechanical means. I had been led by the researches which were commenced in 1868, and carried on through 1869 and 1870, to a general view of what may be termed a *vertical oceanic circulation* dependent upon difference of temperature alone; which appeared to me to be extremely important as accounting for certain facts in the distribution of the surface-temperature of the sea, and of terrestrial climate affected by it, which the ordinary ideas based on the Gulf Stream and other surface currents did not appear to me satisfactorily to explain. I have within the last few months learned that a doctrine entirely accordant with my own, and expressed in so nearly the same words that I might almost be thought to have myself adopted them, was promulgated in 1845, by a very eminent German physicist, Lenz, then professor at St. Petersburg, who had accompanied Kotzebue in his second circumnavigation voyage, 1825 to 1828. As this is one of the most curious examples of scientific anticipation with which I am acquainted, I would ask your attention to two or three facts I shall now state in respect to it.

When it was settled that Professor Lenz was to accompany Kotzebue on this voyage, he and his colleague, Professor Parrot, also a physicist of great eminence, tested the ordinary self-registering thermometers, for the purpose of determining the effect of pressure upon them. Having subjected these to hydrostatic pressure in a powerful press, they came to the conclusion that they were so much affected by that pressure, that they were valueless as indicators of the temperature at great depths. They then gave up the idea of using such thermometers, and

applied themselves to work out some other mode of obtaining deep-sea temperatures. The one which they devised certainly seems very bungling; and any seaman would at once say it would be exceedingly difficult to work satisfactorily, especially without the aid of the donkey engine with which all large steamers are now furnished. This method consisted in sending down a large wooden cask heavily weighted, with valves at the top and bottom; so that as, in its descent, the water would stream upwards through the valves, and these would close so soon as an upward movement was given to the cask, the water brought up in the cask would be that of the greatest depth to which it should have sunk. It was considered that a large bulk of water being thus brought up, and this being enclosed in a comparatively non-conducting case, it would retain its bottom-temperature almost unaltered; and the eminent French physicist, Biot, supplied Lenz with a formula for the correction which he should apply to the temperature actually observed when the water was brought to the surface through the warmer upper stratum, so as to make it indicate the temperature of the bottom water. Lenz published his observations in the Transactions of the St. Petersburg Academy in 1829; but they excited little notice; and he did not publish any general deductions from those observations until 1845, when D'Urville, the celebrated French circumnavigator, published his conclusion that the general temperature of the deep sea was 39°, alike in the equatorial and in the polar areas, a conclusion subsequently confirmed by the observations of Sir James Ross. Being convinced of the fallacy of D'Urville's observations and conclusions, Lenz published a short paper in the Proceedings of the St. Petersburg Academy, giving his general deductions from his own observations, and claiming that these were more trustworthy than the conclusions of D'Urville. That paper seems until recently to have escaped the notice of every writer who has subsequently taken up this subject. My eminent friend, M. Dumas, the Secretary of the Academy of Sciences in Paris, told me in the spring of last year that he did not know any one who had taken a view at all similar to mine, except Pouillet, with whose general opinion on the subject (never very definitely expressed) I was well acquainted. But in the summer of last year I learned from Professor Prestwich, of Oxford, that in searching out everthing that had been done on the subject of deep-sea temperatures, he had come upon this curious little paper of Lenz's, which I at once read with the greatest interest, finding almost in the very same words the general conclusions I had myself come to. The results obtained by Lenz's method, difficult and unsatisfactory as it seemed, really anticipated most remarkably, so far as they went, the temperature-observations taken by the "Challenger." But then Lenz's temperatures were almost entirely bottom-temperatures; with this exception, that he took temperatures with the ordinary thermometers down to about 400 fathoms. The conclusions at which Lenz arrived, and which were precisely the same as those I expressed in this room two years ago,[1] were these:—that owing to the greater density of polar water in consequence of

[1] See Journal, Vol. XVII, Page 528, *et seq.*

its low temperature (the fact that *sea* water continues to contract down to its freezing point at or below 27° being very well known to Lenz, although it had again escaped general attention,—I believe Sir James Ross and Sir John Herschel were both ignorant of it), a column of water of any given height will be much heavier when that water is at 29° or 30°, than a column of water we will say at 60°. If that be the case, it will also have greater lateral pressure; and the consequence will be that in any long vessel of water which is cooled at the surface at one end, and heated at the surface at the other, there will be a continual descent of water at the cold end, a continual flow of water along the bottom towards the warm end, a continual rising of water at the warm end, and a continual flow of the water which has become heated at the surface from the warm end towards the cold end again. I have exhibited this experiment at the Royal Institution more than once, by putting a box with freezing mixture on the surface of water at one end of a trough, and a heated plate at the other end; by that means I was able to keep up the circulation as long as the freezing mixture retained its low temperature. If you apply that to the case of the great ocean basin, you will at once see what we should expect as the result of this constantly-maintained opposition of temperature.

That was the view I presented in the former lecture; and I further developed this point,—that such a circulation would bring up cold water nearer the surface under the Equator, than it does anywhere in the Temperate zones. Now this fact had been actually discovered by Lenz, and had formed part of the basis of his doctrine. In ignorance of his discovery, I predicted that it would be the case; and I shall presently show you that the prediction has been verified by the "Challenger" soundings. Having found by the temperatures he took from the surface down to 400 fathoms, that there is a band of colder water underneath the Equator than there is on either side of it, and having also proved by his bottom-soundings the presence of polar water over the sea-bottom under the Equator, he affirmed that the only possible explanation of that band of cold water under the Equator is, that it is the polar water coming up from below. This is what Lenz had distinctly laid down in this paper of 1845; and all who were present here at my former lecture will recollect that that was precisely the expectation I stated of what the "Challenger" expedition would bring out.

Then I further pointed out, that owing to the difference in the freedom of communication between the two polar basins and the oceans in connection with them, there would be a much larger flow of Antarctic water into the Atlantic basin than of Arctic water, because the communications between the Arctic and the North Atlantic are, comparatively speaking, indirect and narrow. The channel between Iceland and Greenland, which, when looked at on a globe, not on a Mercator's chart, is seen to be really a narrow one, is the principal of these communications. The channel between Iceland and the Faroe Islands is blocked against the cold flow by a bank, which rises sufficiently near the surface to keep it back. Between the Faroe

Islands and the Shetland and Orkneys, there is that remarkable channel which I have ventured to christen the "Lightning" Channel, after the name of the surveying vessel assigned to us in 1868, in which the first observations were made that have eventuated in the "Challenger" expedition. The water to which this channel would give passage is a mere rivulet in comparison with the great basin of the Atlantic; and yet we found that through that channel was flowing a stream of ice-cold water below 30° of temperature, obviously passing towards the great basin of the Atlantic, and helping to keep down its temperature. Comparing the sum of all these with the complete, unrestricted communication between the Antarctic basin and the South Atlantic, I ventured to predict that we should find the South Atlantic altogether much colder than the North Atlantic; that the bottom-temperatures would be lower; that the cold water would flow over its bottom in a greater mass, and that very probably the Antarctic flow would pass northwards beyond the Equator, and show itself in lowering the bottom-temperature to the north of the Equator, instead of meeting the Arctic underflow beneath the Equator. I shall be able to show you that this prediction has been completely verified.

In the first place I may state, upon the authority of a very competent judge, that the working out of what may be called the "temperature-stratification" of the Atlantic alone, is the grandest single contribution that has ever been made to Terrestrial Physics. It gives us the temperature-stratification for about 15,000,000 square miles, carried down from the surface of the ocean to an average of 15,000 feet of depth: that is, a depth about the height of Mont Blanc.

Now I will briefly trace the course of this work. The first Section which I was able to exhibit to you on a former occasion in this theatre,[1] was taken from Teneriffe at 28½ to St. Thomas's at 18½. You observe the upper strata given in successive bands, each band representing 5° of temperature. This thicker line represents the isotherm of 40°; and all below 40° may fairly be considered as polar water, with some admixture of water of a higher temperature. The depth of this mass of polar water is very much greater than the depth of the warm water above; and in fact the strata from 65° to 70°, 60° to 65°, 55° to 60°, 50° to 55°, 45° to 50° are very thin. Indeed, we may assume that from 45° downwards, by far the greater mass of the Atlantic is water that has been more or less cooled down by the polar underflow. There is a very distinct proof of this, in which I find that D'Urville anticipated me. I have brought forward on more than one occasion the contrast between the temperature of the Atlantic and the temperature of the Mediterranean. Sir Alexander Milne will doubtless remember that when I had the pleasure of dining with him on board his ship in Gibraltar harbour, we were speaking of the deep-sea temperatures; and he told me, "I have been taking temperatures in the "Mediterranean, and I find that after the first 100 fathoms the tempe-"rature is uniform." Going into the thing very systematically and carefully that summer, I found it precisely as Admiral Milne had stated. The surface-temperature went up to 70°, 75°, and 80° between

[1] Plate XLV, Vol. XVII.

[illegible]

of extraordinarily deep soundings taken by one of the American exploring vessels near Japan. I must say I utterly mistrust those soundings, for I cannot believe the depths can be as great as they are represented—6,000 or 7,000 fathoms;[1] and certainly the inference drawn, that that enormous depression was scooped out by the surface current, is perfectly ridiculous and absurd.) This curious depression seems to be a sort of volcanic hole. Captain Nares was very confident about the truth of this sounding, 3,875 fathoms, though it showed a depth nearly a thousand fathoms greater than that of any part of the Atlantic previously sounded. It was a good up and down sounding; all the circumstances were favourable, and they could very well tell when the sounding apparatus reached the bottom. Further, there was a very curious fact which proved that that sounding was really a much deeper one than any that had been taken in making the previous section; namely, that the thermometers, protected according to the method I described to you in my former lecture, were both of them crushed by the tremendous pressure. They had been subjected over and over again to a pressure of $3\frac{1}{2}$ tons on the square inch, but they could not stand a pressure of nearly $4\frac{3}{4}$ tons.

The soundings taken in the neighbourhood of Bermuda verified the idea that this group of coral islands is really the summit of a very tall column of coral, not the top of a submarine mountain; for the proportion of its base to its height seems far too small for any mountain with which we are acquainted, being quite different from that of the Matterhorn for example. The slope was found to be so steep outside the Bermuda platform, that dredging could not be carried on upon it. I must not go into the theory of this; but taking Mr. Darwin's view of the structure of the coral islands, I should judge that this column, the base of which probably rests on a submarine mountain, must have been built up during a progressive subsidence of the bottom; the coral animals growing sufficiently fast at the summit to keep the living stratum near the surface, while the bottom was gradually sinking, for if they were once depressed 120 feet below the surface they would have ceased to live.[2]

The "Challenger" then went north to Nova Scotia and New York, and in this section (Plate XLIIa, No. I)[3] is a point to which I wish specially to direct your attention. You all know that there is an Arctic current coming down between the Gulf Stream and the coast of America; and that the transition between this current and the inner side of the Gulf Stream is very abrupt, constituting what our American friends call the "cold wall," though the Gulf Stream on its outer side graduates almost imperceptibly into the general surface-stratum of the Atlantic. On an occasion on which this cold wall was crossed by our Chairman, a thermometer, hanging from the bow of his ship in the Arctic current showed 43°, while a thermometer hanging from

[1] The greatest depth really determined by the "Tuscarora" was 4,655 fathoms.

[2] The "Tuscarora" soundings in the North Pacific indicate that a much more rapid depression, submerging several coral islands, has taken place in that area.

[3] The Institution is indebted to the Council of the Royal Geographical Society for the use of the Plates where the illustrations to this lecture were taken.—Ed.

You see that these facts all correspond precisely with the anticipations I ventured to form; and I have brought them into distinct view in Section IV, projecting a certain series of soundings, so far as to follow a north and south course between 38° N. lat. and 38° S. lat. Here you see the upper layer generally diminishing in thickness, coming under the Equator to its extreme of thinness and then gradually thickening again, whilst the surface temperature diminished; while at the bottom you observe the Antarctic flow of water below 35°, which shews itself northwards as far as St. Thomas's. This section also brings into distinct comparison the excess of thickness of the warm upper stratum of the North Atlantic, as compared with the corresponding stratum in the South Atlantic. This I am disposed to connect with the relative forms of the two oceans; for while the North Atlantic contracts in breadth as we follow it northwards, so that its poleward-moving upper stratum will be compressed laterally, and therefore thickened vertically, the South Atlantic widens out as we follow it southwards, so that *its* poleward-moving upper stratum will tend to spread out laterally, and therefore to thin away.

Now there is a most remarkable confirmation of this view of the uprising of the polar water, in this circumstance,—that according to the observations made in the "Challenger," which fully confirm those previously made by Humboldt, Lenz, and various other observers, whilst the *salinity* of the surface-water increases as far as the Tropic, say from 38° north, it was found to diminish towards the Equator, and then to increase again in passing to the south. In a lecture I gave three years ago at the Royal Institution, I ventured to surmise that this reduction of salinity in the equatorial zone is due to the up-rising of the polar water from below; and in this, too, I now find myself to have been anticipated by Lenz. Observe what takes place here. Polar water is heavier because it is so much colder; but it is less saline. The colder water may be traced the whole way along the sea-bed, from the Pole to the Equator, not only by its reduced temperature, but by the lower specific gravity, it shows when compared at the same temperature with the surface water of the temperate region. If polar water be coming up from the bottom, under the Equator, the salinity of equatorial water will thus be reduced: and that is precisely what was found by the observations of the "Challenger." I think that, putting those things together, you cannot hesitate in the belief that there must be a continual uprising of Polar water as represented in this diagram.

Then there is another thing,—the depression of the surface-temperature of equatorial water,—a point of very great importance, both scientifically and practically. I was not myself at all prepared for the evidence which this affords, until I came to acquaint myself with the temperatures reached in the Red Sea. The Red Sea does not receive so strong an insolation as Equatorial water, because, of course, under the Equator, the sun shines almost vertically the whole year round. Yet we find that in the Atlantic, under the Equator, the water very rarely rises above 80°; excepting under the influence of land, along the Guinea Coast, for instance, where the bottom is shallower, so that

there is no polar water to come up to the surface, and where the surface-temperature rises to 85° and 87°. But in the Red Sea, the temperature rises very much above this; and collecting the observations made upon the subject in the voyages of the Peninsular and Oriental steamers, we find that during August and September it is very common for the temperature of the Red Sea to rise to 96°, 98°, 100°. and in one voyage it was found, on three consecutive days, to range from 98° to 104°. Nothing of this kind was ever known under the Equator in the open Atlantic; and why? Because, as I believe, the equatorial surface-temperature is moderated by this continual uprising of polar water from the bottom.

Look again at the geographical position of the Mediterranean, which lies for the most part between 34° and 40° N. lat., as compared with the equatorial Atlantic. In the Mediterranean, during the summer months, I have myself seen the surface-temperature range for two months between 75° and 80°; and that is just about the annual range of the surface-temperature underneath the Equator. You see, therefore, what an extraordinary moderating influence this uprising of polar water has upon what would otherwise be the unbearable heat of Equatorial regions.

I would just return to the interesting fact that the "Challenger" has met with several cases of what was pointed out some years since by Captain Chimmo, in his survey of the Sulu Sea which lies between the northern extremity of Borneo and the Philippine Islands. Though this is not apparently a circumscribed sea on the chart, it is really circumscribed; for there are reefs which rise nearly to the surface, and a line of small islands, altogether enclosing a deep depression. Captain Chimmo found that the temperature of this sea closely corresponds down to a certain level with the temperature of the China Sea outside, presenting almost precisely the same stratification: but that from this level downwards, the temperature is uniform, continuing so to the bottom. That clearly shows, as Captain Chimmo said, that there is a polar underflow, which is prevented from acting on that deeper portion of this sea which is shut in by these encircling reefs. The "Challenger" has met with cases of the same kind; and this conclusion has been arrived at; the temperature stratification outside being known, the depth to which the communication extends may be judged of by what is the constant temperature down to the bottom; because, supposing this communication to stop at any given plane, the temperature of the water at that plane would be the constant temperature of all the waters beneath it.

Now let me say a few words upon the deposit in process of formation upon the bottom of the Atlantic Ocean. We were able in our "Porcupine" expeditions to confirm all that had been previously stated with regard to the enormous extent of the white mud composed of the calcareous remains of those curious little animals, the *globigerinæ*, which are excessively minute shells formed by animals of the utmost simplicity—little jelly-specks—the size of these shells being so minute that hundreds of them would only weigh a grain. It has been found, by microscopic examination of Atlantic soundings many years

before, that over a very large part of the bed of the Atlantic there is a deposit of unknown thickness, composed either of the shells themselves, or of their disintegrated remains. We ourselves brought up in one instance, near the Faroe Islands, as much as half a ton of this white mud, composed almost entirely of the remains of these globigerinæ. In the first very deep dredging, 2,435 fathoms, off Ushant, in 1869, 1½ cwt. of this Atlantic mud was brought up, with a considerable number of living animals. We then came to the conclusion that these animals are living on the bottom. I never myself denied that they might be found floating on the surface also; but I was very strongly of opinion that they were alive on the bottom; and we know that they afford food to other marine animals of the same locality. In fact, I have been accustomed to say, we ourselves feed upon them indirectly; for we send our fishing vessels to the Faroe and Iceland banks to fish for cod; the cod feed upon a particular kind of star-fish that abounds there; and, upon examining the star-fish, we found their stomachs loaded in the same manner with globigerinæ; so that we may trace some of the protoplasmic material of our bodies back to the globigerinæ. One of the remarkable observations made in the "Challenger" has been, that the floating of these animals is very much more frequent and general than was previously supposed. By carefully searching, not only the surface-stratum, but the 100 fathoms stratum with nets hung from the ship, they caught these animals in large numbers and in very curious conditions; for those that they found floating from the surface had the most delicate possible calcareous spicules radiating from them. Professor Wyville Thomson has entirely changed his previous opinion, that these animals live at the bottom, and concludes now that they do not live at the bottom at all, but only drop there after death. I am still unable to adopt this conclusion, because, having made a special study of these shells twenty years ago, I found the shells of the animals lying on the bottom to be very much thicker than those of the young animals found floating. I could not believe that the former *could* float. If the calcareous shell comes to be so thick that its excess of weight above the sea water is greater than the buoyancy of its contents, of course it must sink; and I am still inclined to the belief that they both live and breed at the bottom, for I have obtained water at the depth of 700 fathoms which was white with minute globigerinæ, floating just above the mass of globigerinæ mud that covered the bottom. I have been lately re-examining my old sections; and I see, as Dr. Wallich had also seen, that the shell is so thick that we cannot believe it could have floated after having acquired that thickness. Hence I am disposed to believe that the *globigerinæ* breed at the bottom, that the young rise to the surface and live near it during the whole time that their shells are increasing in the number of their chambers. There are generally about sixteen chambers in the adult: and when the whole of the chambers have been formed, and formed as very thin shell, then the calcareous matter which would go on forming new chambers is not so used, because the chambers are not further multiplied; and my belief is, that then the calcareous matter is deposited upon the surface, in-

creasing the thickness of the shells; and that when the shell has attained a certain thickness, the animals sink to the bottom, still continuing to live there, as other Foraminifera can be certainly shown to do.

Now I come to another very interesting question, namely, that of the origin of a very remarkable deposit of red clay, which has been found by the "Challenger" over considerable parts of the area of the Atlantic, having been especially noticed in the section between Teneriffe and St. Thomas's. They first came upon it in the deepest part of the eastern basin; and then after passing the "Dolphin Rise" they came upon it again. Professor W. Thomson at first very naturally surmised that this red clay is the product of some great river discharging its contents into the Atlantic; but he failed to be able to trace it to any such source, and did not find it in any but very deep water, where it seemed to take the place of the *globigerina ooze.* Hence he has been led to the conclusion that it is in some way or other derived from the globigerina deposit itself; and has offered this surmise—that it is (as it were) the ash left by the shells of the globigerinæ, when their carbonate of lime has been dissolved by an excess of carbonic acid in the very deep water. He thinks that, as this excess increases with the depth, the very deep water will dissolve the calcareous shells of the globigerinæ, leaving an insoluble residue, this combination of silex with alumina and iron. The only evidence he gives of it is, that he took some of what is called the globigerina ooze—not that formed of living shells, but the result of their disintegration—and that, on analysis of this, he found a small residue of red clay, amounting to about one per cent. My surmise (for I do not offer it as more) is of a different kind, and is connected with another very curious fact, encountered on a large scale in the "Challenger" expedition. It was many years ago observed by Professor Ehrenberg, that on examining the grains of green and ochreous sand, occurring at various geological periods, also composed of silicate of alumina and iron, he was able to recognize in them most distinctly the forms of the internal cavities of Foraminiferal shells, these grains being the internal casts of various kinds of *foraminifera.* Soon afterwards, the soundings obtained by the United States Coast Survey in the Gulf of Mexico having been microscopically examined by the late Prof. Bailey, of West Point, he found in them representatives of living foraminifera, whose cavities were similarly filled, showing that the like process is taking place at the present time. This set going a like enquiry on the part of those who had been paying attention to the subject on this side of the water; and having put into dilute acid some specimens obtained by Mr. Jukes in his dredgings on the coast of Australia, we got out the most perfectly beautiful internal casts—models of the animals which formed the shells—by dissolving away the shells with dilute acid. Three or four years ago, I came into possession of some dredgings which Captain (now Admiral) Spratt had made in the Ægean some years previously; and in the foraminifera of these Ægean dredgings I found the same thing—the most perfect green and ochreous internal casts of living Foraminifera.

Again, I find in the "Challenger" reports, that on the Agulha: Bank there was brought up a quantity of green mud, which on exa mination with the microscope was found to be entirely composed o these internal casts, the shell having been got rid of, possibly by fric tion, which is not at all unlikely in a current. This green mud, then is the result in the first place of the deposition of a ferruginous silicat in the place of the animal. How this deposition occurs is a curiou: chemical question, which I brought under the attention of the Chemica Section of the British Association, last autumn, at Belfast. It is on of singular interest; and there was no hesitation among the eminen chemists present in endorsing my view that this deposition is the resul of chemical *substitution*, the deposit of silicates taking the place of th animal matter. It seems impossible to account for it in any other way Why it should occur in some localities and not in others, we are not a present able to explain; possibly there may be differences in the com position of the sea-water covering different parts of the sea-bottom But here is the fact that the ferruginous silicates are drawn into th cavity of the shell, and are deposited from the solution as solid minera bodies, during the decay of the animal substance which previousl occupied those cavities. Now my suggestion is that this red mud i simply a chemically metamorphosed form of this internal deposit; anc we have this further evidence of it, that amongst Captain Spratt': specimens I find several of the internal casts which are formed, not o a green or ochreous silicate, but of a *red* material; and one in whicl the green graduates into the red, clearly showing that there is som chemical agency which tends to convert the green mineral into a rec mineral, probably by a change in the oxidation of the iron. Hence I do not think it is at all difficult to understand that further change should produce a disintegration of this mineral; for we find in some of these casts the green mineral clearly efflorescing into a yellow powder. That is the explanation which I venture to offer; it is on its trial at present. A good deal of discussion will no doubt take place as to the whole subject. I shall have a number of the larger foraminifera carefully analysed; and if I find that these shells do not yield any ash from which this red mud can be derived, I shall have a right to say that the globigerina shells do not contain it. If I find that it does yield a red residuum, then I shall be perfectly willing to accept my friend Professor Wyville Thomson's view, that this red ash is the result of the solution of the calcareous part of the globigerina shell. I am very strongly inclined to agree with him that in any case this red mud is probably a derivative of this remarkable globigerina deposit, taking its place where we do not find the globigerina ooze: and in that point of view it is a fact of singular geological interest which I must not now detain you to dwell upon. You will find a very interesting lecture on it by Professor Huxley in the last number of the *Contemporary Review*, to which I refer you for a masterly summary of the facts at present known in regard to the agency of minute forms of animal and vegetable life in producing both calcareous and siliceous deposits on the sea-bottom.

The CHAIRMAN: We all feel deeply indebted to Dr. Carpenter for the kind

manner in which he has come to this Institution, and given us such valuable information with regard to the interesting soundings taken by the "Challenger." There is no doubt that the theories which have been established of the great depths of the ocean and of the polar current have been clearly portrayed by Dr. Carpenter in the diagrams which he has put before us; and it is certainly a matter of great interest to trace the curious theory which has now been established of the polar current rising from great depths to near the surface in lat. 22, and even to the north of the Equator. Dr. Carpenter alluded to the Gulf Stream, and happened to mention my name. With regard to that remark, it was a simple observation going from Bermuda to Halifax, when we were passing from the Gulf Stream into the apparently colder water on the banks of Nova Scotia. We saw smooth water a-head and a well-marked line of tide, and having always taken the temperatures from Bermuda to Haxifax, the small bucket was put over as the ship's bow was approaching the line of demarcation, and the temperature was 66° or 67°; and the moment we got over this current line into smooth water, the temperature was 43°. I was very much struck with it at the time, and attributed it to the fact that it was the Gulf Stream impinging upon the banks of Nova Scotia, and bringing up the cold water from below that had come from the polar regions. Dr. Carpenter also alluded to the temperature in the Mediterranean when my flag-ship was lying inside the Mole at Gibraltar. I found the temperature of the surface water was 70°, but at the keel of the ship it was 59°. This seemed to me to be caused by the great rush of the current at the entrance of the Mediterranean bringing up the cold water from below. I found it so useful there that we kept the ship alongside the Mole several days in order to get the ship cooled down. I found the same reduction of temperature in the Straits of Messina, the strong current brought to the surface the cold water from below, reducing the temperature at the anchorage to 60° and 61°; and I felt at that time that the temperature was the most cool and agreeable that we had experienced in the Mediterranean.

I am sure I may convey the thanks of this meeting to Dr. Carpenter for the very interesting and instructive lecture he has so kindly delivered to us.

Friday, July 2nd, 1875.

ADMIRAL SIR HENRY J. CODRINGTON, K.C.B., in the Chair.

EXPLANATION OF A JURY-RUDDER.

By Captain Sir J. E. COMMERELL, V.C., K.C.B., &c., the Inventor.

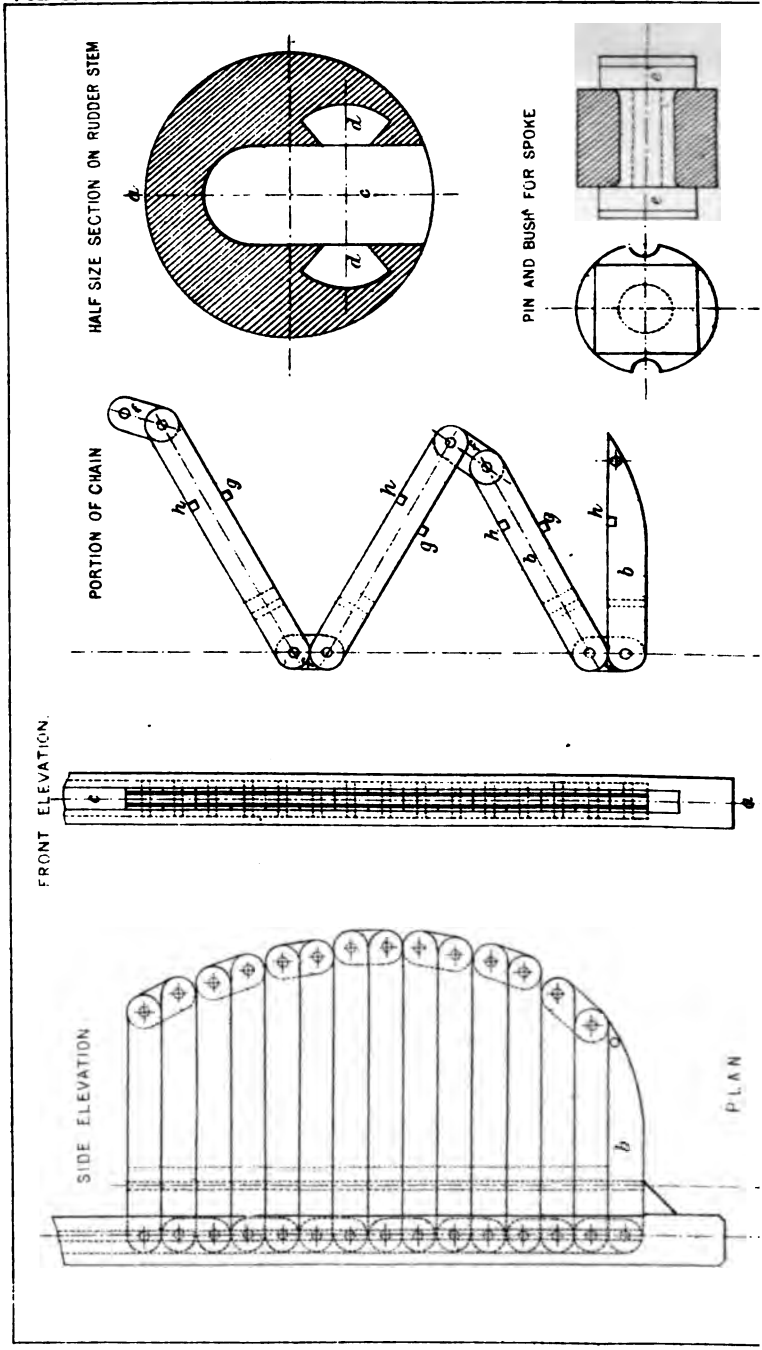
I NEED not, I am sure, suggest to you how necessary it must be, not only in the Navy, but also in the Packet and Merchant Service, to be prepared in case of accident to supplement that governing power, without which, however well a ship may be commanded, manned, and steam-powered, she must be comparatively helpless. In the days when our Navy was composed of wooden ships, it was considered a great feat of seamanship to rig a jury-rudder, and with it take the ship safe into port.

Take the memorable case of the "Pique," commanded by Captain Rous, when the ship, by means of a Pakenham rudder, was navigated across the Atlantic, and gained for that gallant officer a name, which will live in the traditions of the Navy.

In the present day, when our Navy is mostly composed of iron-clads with steam-power, it is far more difficult than formerly to extemporise a rudder, not only that ships when rudderless are more difficult to steer under steam than under sail, except in cases of twin-screws, but also from the guys fouling the screw, and further, from the rudder-trunk being too small to take a topmast. When we look at the various models of jury-rudders on the table before us, I think that you will agree with me that it would be impossible to apply any one of them to an iron ship within reasonable time.

It has been said, that the loss of rudder is of such rare occurrence, that it is hardly necessary to be prepared with an expensive fitting to meet such an uncommon contingency. In the Navy, no doubt the loss of a rudder is almost unknown, but still cases have occurred. The "Inconstant" lost her rudder shortly after leaving Pembroke. The "Lord Clyde," when on shore off Pantallaria, had her rudder so damaged as to be almost useless. In 1866 a splendid frigate lost her rudder off Cape Horn, and was nearly wrecked in consequence. The Constructors' Department of the Navy, fully alive to the necessity of being prepared to meet every contingency, have always endeavoured to supply the want.

In the Packet and Merchant Service generally, the loss of rudder is


HALF SIZE SECTION ON RUDDER STEM
PIN AND BUSH FOR SPOKE
PORTION OF CHAIN
FRONT ELEVATION.
SIDE ELEVATION
PLAN

of far more frequent occurrence; and the first inducement I had to consider the subject was a paragraph in the *Times*, which told of seven steam-ships being adrift in the Atlantic, with lost and damaged rudders. How many of that sad list of "missing vessels" may be attributable to similar accidents we shall never know.

The plan which I now lay before you, Gentlemen, is still in its infancy. I am by no means wedded to its details. I dare say, in practice, some may be found defective, others may be greatly improved upon, and it is almost impossible, in models, to work out minute details in a satisfactory manner. You may, however, be glad to know that I have already tried a rudder which, in a sea-way, was shipped in five minutes, and steered a vessel of 35 tons. I am happy to say that the Lords of the Admiralty have permitted me to forward plans, with a view to its being tried on a larger scale; and though I have doubt that, with heavier weights, obstacles will have to be overcome, yet in this world nothing can be done without patience and perseverance, and if I can only succeed in helping my brother sailors from a lee-shore when rudderless, I shall feel myself amply repaid.

Explanation of Plan.

(*a*) is a trunk or cylinder, composed of wrought iron, with a large groove (*c*) cut out of it; dovetail grooves (*d*) are again cut in groove (*c*).

(*bbb*) are pieces composed of wood, plated with iron, and fitted at one end with movable pins (*e*) with dovetail heads. When the old rudder is lost or removed, trunk (*a*) is lowered down the rudder-hole, which it is made to fit, until it rests on the sole-plate. If this should be carried away, or there should be none, (*a*) is supported in its place by a movable collar, on rollers, and the rudder-chains are secured to the lower end and set taut to each quarter. The pieces are then lowered, end-on, down the trunk-pin end *first*. If the pieces (*bbb*) are used separately, a tripping-line from the lower end cants each piece out at right angles to (*a*). As soon as it touches the piece below it, and it is prevented falling out of the trunk altogether by the pins (*e*), which run in grooves (*d*), the form of the pins and grooves preventing the tube from opening when lateral strain is brought on it. If (*bbb*) are fastened together by the links (*ff*) as in an endless chain, each piece on reaching the bottom forces out the piece above it, and as each piece falls on the top of the piece below it, the studs (*gg*) fall into the slots (*HH*). When the rudder is made up, the whole is tautened up by a screw down the trunk.